

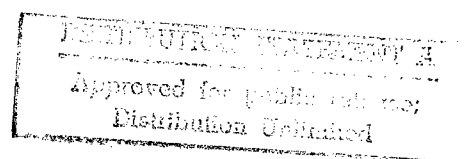
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A N N I V E R S A R Y  
1941 - 1991

# ***JPRS Report***



# **Science & Technology**

***Europe***

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# Science & Technology Europe

JPRS-EST-91-010

## CONTENTS

10 June 1991

### WEST EUROPE

#### ADVANCED MATERIALS

BASF Develops New Ceramic Manufacturing Process [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT, 16 May 91] .....	1
--	---

#### AEROSPACE

Project Funding for HERMES, COLUMBUS in Doubt [Goetz Wange; Stuttgart FLUG REVUE, Apr 91] .....	1
Arianespace Analyses Launch Services Market [Evry ARIANESPACE NEWSLETTER, Mar 91] .	2
Airbus Industrie Studying Competitor for Boeing 747 [Volker K. Thomalla; Stuttgart FLUG REVUE, Feb 91] .....	5
First European Earth Remote Sensing Satellite Ready for Launch [Goetz Wange; Stuttgart FLUG REVUE, Feb 91] .....	5
EC: Space Station Logistics Vehicle Program Planned [Brussels ATHENA, Feb 91] .....	6
French Firm Presents Light-Weight Aircraft Propeller [Toddington NEW MATERIALS INFORMATION, Mar 91] .....	6
Germany's HYTEX Scouting Out Space Transporter Technologies [Michael K. E. Hauger; FLUG REVUE, Apr 91] .....	7
German Researchers Develop Transputer-Based Cockpit Displays [Jochen Neidhardt; Bonn DIE WELT, 18 Mar 91] .....	11
Italian, Soviet Aerospace Agreements Signed .....	12
Experimental Satellite Links [Rome AIR PRESS, 27 Mar 91] .....	12
Remote Sensing [Rome SPAZIO INFORMAZIONI, 3 Apr 91] .....	12
Italy: Italian Delegation to ESA Conference Interviewed .....	12
Italian Space Agency President [Luciano Guerriero Interview; Rome SPAZIO INFORMAZIONI, 6-13 Feb 91] .....	12
ESA Council President [Francesco Carassa Interview; Rome SPAZIO INFORMAZIONI, 27 Feb 91] .....	14
Italy: Conference on Columbus Precursor Flights Summarized [Rome SPAZIO INFORMAZIONI, 20 Feb 91] .....	15
Italian Aerospace Projects Presented .....	16
Interplanetary Probe [Rome AIR PRESS, 20 Mar 91] .....	16
Computer Systems [Rome SPAZIO INFORMAZIONI, 3 Apr 91] .....	16
Italy: New Telecommunications Satellite Project Described [G. Manoni, F. Mini; Milan SISTEMI DI TELECOMUNICAZIONI, Feb 91] .....	16
Italy: Ansaldo, Elsag Report New Projects [Rome FINMECCANICA NOTIZIE, 28 Feb 91] .....	20
Fokker Develops Ariane Booster Recovery System [Gerard van Nifterik; Rijswijk POLYTECHNISCH WEEKBLAD, 14 Feb 91] .....	20

#### AUTOMOTIVE INDUSTRY

Peugeot Starts Up Parts Recycling Plant [Toddington NEW MATERIALS INTERNATIONAL, Apr 91] .....	22
French Clean Transportation Projects Noted [Paris RECHERCHE TECHNOLOGIE, Feb 91] ....	22
Citroen Combines CAD, Three-Dimensional Measurement [Stephanie Farhi; Paris L'USINE NOUVELLE, 21 Feb 91] .....	24

## BIOTECHNOLOGY

EEC: Bioethics Coordination Center Proposed [Paris <i>BIO LA LETTRE DES BIOTECHNOLOGIES</i> , 30 Jan 91] .....	25
French Parliament Proposes UN Ecosystem Watchdog [Catherine Vincent; Paris <i>LE MONDE</i> , 18 Apr 91] .....	25
France: CEA, CNRS Form Biological Research Institute [Paris <i>AFP SCIENCES</i> , 21 Feb 91] .....	26
French Program for Deviant Gene Identification Launched [Paris <i>BIO LA LETTRE DES BIOTECHNOLOGIES</i> , 30 Jan 91] .....	26
Germany: Electrical Pulses Aid in Genetic Transfer, Cellular Fusion [Frankfurt/Main <i>FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT</i> , 29 Apr 91] .....	27
Germany: Recycling Reduces Costs in Fermentation Operations [Frankfurt/Main <i>FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT</i> , 24 Apr 91] .....	28
German Firm Improves Monoclonal Antibodies Production [Frankfurt/Main <i>FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT</i> , 3 May 91] .....	28
Germany: Second Generation DNA Sequencer Developed [Frankfurt/Main <i>FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT</i> , 2 May 91] .....	29
Germany: Infrared Spectroscopy Applied to Bacteria Identification [Graefelfing <i>BIOENGINEERING FORSCHUNG &amp; PRAXIS</i> , Feb 91] .....	29
Germany: Special Biotechnology Projects Approved [Graefelfing <i>BIOENGINEERING FORSCHUNG &amp; PRAXIS</i> , Feb 91] .....	29

## COMPUTERS

EC Neural Network Projects Noted [Paris <i>ELECTRONIQUE INTERNATIONALE HEBDO</i> , 14 Mar 91] .....	30
ICL Banned From European IT 'Round Table' [Amsterdam <i>COMPUTERWORLD</i> , 13 Feb 91] ...	31
Germany: Suprenum Supercomputer Firm Restructured [Edam <i>SUPERCOMPUTER EUROPEAN WATCH</i> , Feb 91] .....	31
University of Stuttgart Installs MT-1 Supercomputer [Edam <i>SUPERCOMPUTER EUROPEAN WATCH</i> , Feb 91] .....	32
Netherlands: SBI '91 Private Industry Subsidy Program [Amsterdam <i>COMPUTERWORLD</i> , 13 Feb 91] .....	32

## DEFENSE R&D

Western European Union Proposes Military Satellite Network [Rome <i>AIR PRESS</i> , 3 Apr 91] .....	32
European Missile Agreement Signed [Paris <i>LE MONDE</i> , 7 Feb 91] .....	33

## ENERGY (ALTERNATE)

Germany: Service Stations of Future Underway [Leipzig <i>ENERGIETECHNIK</i> , Apr 91] .....	33
Germany Increases Wind Power Program Funding [Bonn <i>TECHNOLOGIE-NACHRICHTEN MANAGEMENT-INFORMATIONEN</i> , 28 Feb 91] .....	33
German-Spanish Asterix Program Furthers Solar Energy, Chemical Processes Research [Andrea Steinert; Duesseldorf <i>VDI NACHRICHTEN</i> , 1 Feb 91] .....	35

## FACTORY AUTOMATION, ROBOTICS

Backpanel Bus Systems in European Factory Automation Discussed [Mirel Scherer; Paris <i>INDUSTRIES ET TECHNIQUES</i> , 8 Feb 91] .....	36
Austria: Parallel Computers Control Industrial Processes [Wolfgang Mueller; Duesseldorf <i>VDI NACHRICHTEN</i> , 5 April 91] .....	37
France's ONERA Develops Ultrasound Abrasion Machining Process [Marc Chabreuil; Paris <i>L'USINE NOUVELLE/TECHNOLOGIES</i> , 14 Feb 91] .....	38
France: Dassault Robot Prepares Machining Tools [Paris <i>TECHNIQUES &amp; EQUIPEMENTS DE PRODUCTION</i> , Feb 91] .....	39

## LASERS, SENSORS, OPTICS

Germany: Siemens Probing Electrical Power Transmission via Fiber-Optic Cable [Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT, 23 Apr 91] .....	39
France: New Laser Material Under Development [Paris FRENCH TECHNOLOGY SURVEY, Feb-Mar 91] .....	40

## MICROELECTRONICS

EUREKA: 3-D Integration Project Outlined [Paris FRENCH TECHNOLOGY SURVEY, Feb-Mar 91] .....	40
ESPRIT II Project Produce Advanced Workstations [Amsterdam COMPUTABLE, 22 Feb 91] ....	40
Belgian IMEC Develops Optical Circuit [Eric Dauchy; Amsterdam COMPUTABLE, 15 Feb 91] ..	41
Belgian Research Center Contribution To Industry Analyzed [Ridha Loukil; Paris INDUSTRIES ET TECHNIQUES, 22 Feb 91] .....	41
Use of Silicon, Gallium Arsenide Evaluated [Ridha Loukil; Paris INDUSTRIES ET TECHNIQUES, 22 Feb 91] .....	43
Thomson's Color Liquid Crystal Displays Described [Thierry Lucas; Paris L'USINE NOUVELLE/TECHNOLOGIES, 14 Feb 91] .....	43
Philips Upgrades CCD Sensors [Paris ELECTRONIQUE INTERNATIONAL HEBDO, 28 Feb 91] .....	44
Italy: Status of SGS-Thomson's Projects Presented .....	44
Integrated Circuits [Rome FINMECCANICA NOTIZIE, 28 Feb 91] .....	44
EEPROM Devices [Rome FINMECCANICA NOTIZIE, 28 Feb 91] .....	44
UK: Inmos Presents T9000 Transputer [Chichester INTERNATIONAL TELECOMMUNICATIONS INTELLIGENCE, 15 Apr 91] .....	45
Advanced Swiss Amorphous Silicon Deposition Process Described [Ridha Loukil; Paris INDUSTRIES ET TECHNIQUES, 8 Feb 91] .....	46

## NUCLEAR FUSION

France: Thomson Establishes HDTV Subsidiary [Newbury FRANCE ALERT, 3 Apr 91] .....	47
French Firm Develops High-Capacity Optical Disk [Newbury FRANCE ALERT, 3 Apr 91] .....	47
Italy: Nuclear Reactor Consortium's Activities Presented [Rome FINMECCANICA NOTIZIE, 28 Feb 91] .....	47

## SUPERCONDUCTIVITY

France: High-Temperature Superconductor Developed [Paris SCIENCES & AVENIR, Mar 91] ...	47
Germany Develops High-Temperature Superconductor Applications [Bonn WISSENSCHAFT WIRTSCHAFT POLITIK, 20 Mar 91] .....	47

## TELECOMMUNICATIONS R&D

Europe's First Public MAN Inaugurated [Chichester INTERNATIONAL TELECOMMUNICATIONS INTELLIGENCE, 25 Mar 91] .....	48
Italy: Satellite Telecommunications Conference Summarized [Rome SPAZIO INFORMAZIONI, 6 Mar 91] .....	48

## EAST EUROPE

### COMPUTERS

Hungarian Firm To Become East European Supply Base [Budapest COMPUTERWORLD/SZAMITASTECHNIKA, 20 Dec 90] .....	50
--	----

## ADVANCED MATERIALS

### BASF Develops New Ceramic Manufacturing Process

91P60177 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 16 May 91 p 8

[Text] The manufacture of various temperature- and corrosion-resistant products made of metallic oxides is difficult because, for a long time, it was barely possible to control their brittleness and susceptibility to fracture. BASF AG in Ludwigshafen has taken a step in this direction with a new manufacturing technique for which a patent is being sought. [In this technique], metallic oxides are mixed with a plastic which ensures the retention of crystalline ceramic particles and facilitates processing. With this step [forward], BASF is the second German chemical firm that would like to remain in the running in the ceramics market of the future.

For manufacturing preformed ceramic parts, the metallic oxides having a particulate size of mere fractions of a micron are mixed with Polyacetal which functions as a bonding agent. After a cooling period, this mixture is again ground into a granular material and can then be melted and molded in conventional injection molding machines. Since this ceramic-plastic mixture is still up to 40 percent plastic, [the plastic] must be removed in a follow-up processing step. This is done in a tempering process with temperatures up to 500 degrees Celsius.

Moreover, technicians have worked out a catalytic process that releases the plastic matrix in such a way that it cannot lead to any overly extensive formation of pores and fissures. This process takes place rather slowly—one to two millimeters per hour—and uses gaseous nitric acid. After the plastic has been completely removed, the metallic oxides must of course be sintered at prescribed temperatures into preformed pieces.

The technique works with aluminum, zirconium, silicon and iron oxides (ferrites) as well as with silicon nitride and special steel oxides. The variable pore size ranges between 0.2 and 20 microns; the grain sizes of the ceramic particles range from 0.2 to 2 microns. Material compacting can be brought up to around 60 percent of the theoretical value. Of course, the process includes several stages; but, BASF reports that it ensures excellent shape precision and contraction that can be adequately controlled, which latter consideration must surely be factored into all contemporary ceramic manufacturing processes.

BASF asserts that the process, despite its many stages, is designed [to be] simple and cost-effective for the production of high-strength structural ceramics. Moreover, it is bringing into play its extensive experience with the thermoplastic Polyacetal (BASF trademark: Ultraform) which, along with copolymers, will be used particularly in functional engineering components such as toothed

gears, rollers, disk cams and pump components. The polymer properties contribute substantially to good processability and inadvertently suppress the formation of larger metallic oxide particles. Heretofore, this drawback could not always be totally eliminated by using alcohols, ethers or alginates.

## AEROSPACE

### Project Funding for HERMES, COLUMBUS in Doubt

91WS02282A Stuttgart FLUG REVUE in German  
Apr 91 pp 34-35

[Article by Goetz Wange: "Financing Remains Unclear"; first paragraph is FLUG REVUE introduction]

[Text] Hectic activity at ESA [European Space Agency]: Financial and technical problems necessitate postponing the major manned space flight programs. Only the Columbus docking module could still be launched into space before the year 2000.

There is a violent struggle for positions going on. This has to come to a head at the ESA ministerial conference postponed until the fall, for that is where the final decision will be made as to whether the Columbus space station program and the Hermes orbital glider can be realized. ESA has to make it clear to its member nations whether the hidden technical goals can be achieved and whether the financial boundary conditions set aside for it will be sufficient. Because if that is not the case, the member nations can still renege on the promises they have made. Then the laboriously established joint space flight strategy will collapse like a house of cards.

The large financial expenditures are regarded with particular criticism in Germany. The chairman of the Bundestag Research Committee, Wolf-Michael Cartenhuisen (SPD), recently spoke in Bonn of "questionable space flight plans." According to his calculations there is nearly a 10-billion German marks [DM] gap between the amount of required funding calculated by the Research Ministry and the medium-term financial plan (DM21.8 billion). With the now envisaged delay and cutback of the projects, this deficit could be cut in half. The head of the German Space Agency (DARA), Prof Wolfgang Wild, is also tooting the same horn. To the press he stressed that he had seen good chances of getting by with the DM25 billion in funding until the year 2000 which was agreed in June by the cabinet-level Space Commission. But the budget established for space flight in the medium-term financial plan was by no means sufficient.

### U.S. Space Station With Many Question Marks

As for the postponement of the major programs, the statements by the new general director of ESA, Jean-Marie Luton, are becoming increasingly more concrete. "The time schedule must be adapted to developments in

the United States and Europe," he indicated in Paris. In actual terms, he refers to the inevitable effects of NASA's difficulties in determining the final configuration for its Freedom space station, at which an ESA Columbus module (APM) is to dock firmly in 1998. In order not to further aggravate the uncertainties, all discussions about the free-flying Columbus laboratory (MTFF) and the Hermes orbital glider are to be separated from it. In other words, the MTFF laboratory will initially be supplied and maintained exclusively by the Hermes orbital glider. The result of this is that the launch of the laboratory cannot take place until the year 2001, because Hermes will not be available until then. The new schedule foresees the first unmanned launch for the year 2000. The first manned mission a year later will be used to test the rendezvous and docking procedures.

At the ESA center in Paris the reaction to the criticism recently voiced on the German side regarding the increasingly smaller payload capacity of the Hermes orbital glider is still calm. It is confirmed there, however, that the present design of Hermes allows for only about one ton of cargo capacity into space instead of three. But that is enough to supply the Columbus-MTFF as planned. A subsequent increase in cargo capacity could then be achieved by means of increasing the power of the Ariane 5 booster rocket. This should be contemplated after the rocket's qualification ends in 1995, when Ariane 5 has begun operational transportation of satellites. In a program to increase performance from 1996 to 2001 the present capacity of 23 t for launching a Hermes is planned to be increased to about 24.5 t. An improvement is planned in the turbo pump for the liquid oxygen in the engine of the cryogenic central stage.

It is still completely unknown what the effects of having altered the concept of the U.S. Freedom space station will be on the docked ESA module. NASA will not give out more specific statements until April. The revised version is primarily intended to help reduce the necessary shuttle flights for constructing and supplying the station. But since the first unofficial drafts indicate a shrinking of the station to about half the size, one can hardly assume that the Columbus laboratory can continue to be 13.5 m long and consist of four segments. This size is necessary for the permanent stay of eight astronauts at the Freedom station. But NASA is also flirting with the idea of limiting it to a total of four permanent crew members.

#### ESA Insists on Governmental Agreement

The governmental agreement between the United States and the ESA member nations make such a measure politically difficult, however. But so far that has never deterred the Americans from infringing on the interests of their partners.

#### Arianespace Analyses Launch Services Market

91AN0322 Evry *ARIANESPACE NEWSLETTER*  
in English Mar 91 pp 2-3

[Text] Arianespace published the annual update of its market study and an abstract presenting major trends in the commercial launch services market.

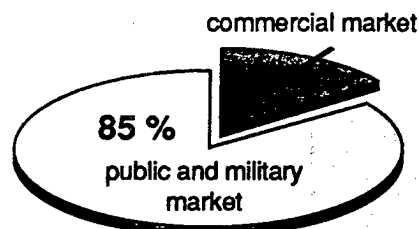
This abstract covers three main elements:

- market definition and characteristics;
- commercial market trends;
- prospects for the next ten years.

#### Market Definition and Characteristics

The global launch market for all payloads, and satellites in particular, over the past five or six years represented 100 to 120 payloads for 85 to 95 launches, carried out primarily by the USSR (75 percent), followed by the US, Europe, Japan and China.

The commercial market represents only about 15 percent of the total market, since all Soviet satellites and all U.S. military satellites are exclusively launched by the countries' respective launch resources.



Furthermore, the commercial market is not systematically open to international tenders, and is thus not always accessible to a commercial launcher (for example, GOES [Geostationary Environmental Satellite], NOAA [National Oceanographic and Atmospheric Administration], Landsat, SPOT [Probational Earth Observation Satellite] or GPS [Global Position System]/Navstar satellites).

The commercial market is also attracting increasing private funding, mainly in the field of telecommunications satellites (70-75 percent).

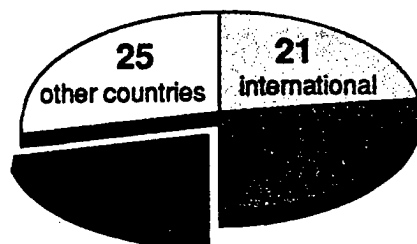
The study focuses on Arianespace's accessible market, compatible with the European Ariane launcher.

#### Telecommunications

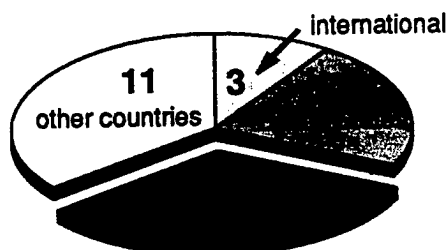
Today, the world's space telecommunications system (excluding USSR) consists of 90 satellites placed in geostationary orbit.

The system, managed by 31 satellite operators, has now virtually reached a balance between supply and demand, with a capacity of 1,755 transponders in orbit.

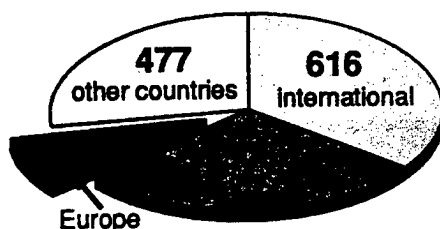
### 90 operational satellites



### 31 satellite operators



### 1,755 transponders in orbit



With the exception of Europe and Japan, over 70 percent of transponders operate in the C-band.

Satellites are primarily employed to distribute television and radio programs to cable networks or to direct broadcast receivers. For voice transmission, satellites complement terrestrial networks and can prove very useful as backup systems (such as Intelsat and Telesat Canada).

The American satellite system, which handled 43 percent of video services in 1986, now handles 65 percent. The sharp growth of this service has taken up all available capacity. This explains the relative stability in the number of transponders (about 500) in the US.

It is important to note that the U.S. system is reaching the end of its lifetime and must be replaced in the next three to five years. On the other hand, the European system is in the final set-up phase. This explains the large number of European satellites launched since 1987 (18 satellites versus 7 U.S. satellites).

Other countries already involved in space activities—Australia, China, India, Indonesia, Japan—continue to

set up their own systems, with 15 satellites launched over the same period. International organizations Intelsat and Inmarsat have renewed and increased their capacity placing a total of five satellites in orbit.

#### *Earth Observation and Meteorology*

Earth observation uses services by ERS [Earth Resources Satellite], IRS [Indian Remote Sensing Satellite], Landsat, MOS [Marine Observation Satellite, Japan] and SPOT. This market does not appeal much to private investors and continues to be mainly operated by state agencies.

The world meteorological system includes satellites in low orbit (GMS [Geostationary Meteorological Satellite], GOES, NOAA) and satellites in geostationary orbit (Meteosat/Eumetsat). This system is operated by national and regional non-profit organizations.

#### *Scientific Applications*

This sector is characterized by very large programs, which are becoming increasingly international and operate over long periods of five to ten years. Since 1987, this market has remained steady, and nine satellites were launched: COBE [Cosmic Background Explorer], CRRES [Combined Release and Radiation Effects Satellite], Galileo, Hipparcos, HST [Hypersonic Transporter], Magellan, Olympus, Rosat and Ulysses.

All told, the commercial market represents about twenty satellite launches per year.

From 1981 to 1985, the number of commercial launches climbed from 10 to 20. It was brought to a sudden halt in 1986 and 1987 after the failures of the Shuttle and several launchers, before rapidly returning to the previously-projected average of 20 (17 in 1989 and 24 in 1990).

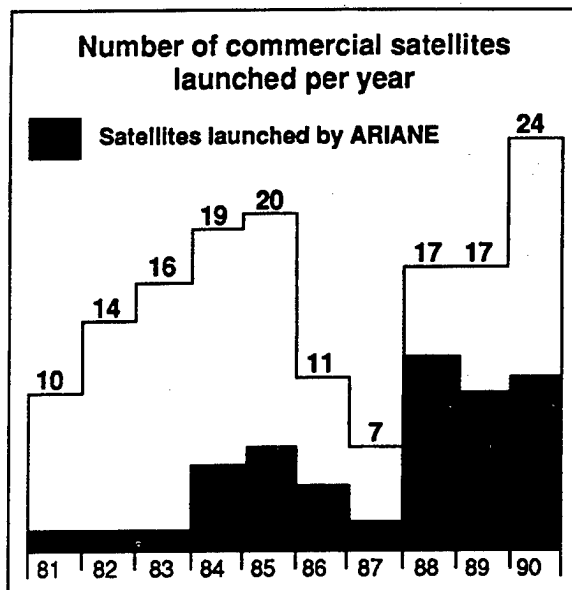
Following graph shows the development of the commercial market and the share of launch services gained by Arianespace.

#### **Commercial Market Trends**

Our market will consist almost exclusively of commercial satellite launches for private operators, along with public sector satellites.

Starting in 1995-1997, additional launch services with capsule recovery will progressively come on stream. This will be followed by Columbus operations and subsequently by Hermes flights. The latter are not yet integrated in our market study.

Beyond the known markets, we also note signs of interest in "lightsats" of a few hundred kilos to be placed into low orbits. Starting in 1994-1995, this potential new market could represent 10 to 20 satellites per year; it



should be serviced by a launcher limited to low orbits. This market is not included in our study either.

The main trends concerning Arianespace's accessible market are as follows:

#### **Satellites**

For about half the satellites, the average mass is increasing from 1,600-1,800 kg to 2,200-2,400 kg, and even 2,600-2,800 kg. We are seeing fewer PAMD/D2-class satellites and more satellites weighing under 1,000 kg (SDS [Spelda Dedicated Satellite]-class), although this trend remains to be confirmed.

Telecommunications satellite capacity is clearly growing with a minimum of 16 to 18 transponders and a tendency towards as many as 24, and even 36-42 on larger satellites.

Satellite lifetimes are being extended from the current 8-10 years to 12-14 years, and possibly 16-18 years, thanks to new technologies used for space equipment and the higher injection precision of launch vehicles.

Transponder bandwidths are also increasing significantly. Wider use of the Ku-band with dual polarization and new multiplex and coding systems enable each transponder to relay more information.

Satellite manufacturers are joining forces along European lines and are also increasingly associating with U.S. manufacturers to ensure optimum technical efficiency and profitability.

Telecommunications satellites are thus becoming heavier, with greater operational capacity and a design

life almost twice as long as that of satellites in service today. Launch resources such as Ariane 5 will therefore be able to fulfill new market needs in the second half of this decade.

#### **Applications**

The main trend will see traditional telecommunications applications expand to include radio-localization, high-definition television, messaging and mobile communications. These applications will generally call on conventional 1,600-2,000 kg satellites.

#### **Market Prospects**

In quantitative terms, our market estimates define three separate periods:

- Short term, 1990-1992, which corresponds to the order books of the three major launch services companies—Arianespace, General Dynamics, and McDonnell Douglas;
- Medium term, 1993-1997, which includes both new projects and the renewal of currently operational systems;
- Long term, 1998-2002, which reflects major market trends and takes into account new applications and new satellite structures.

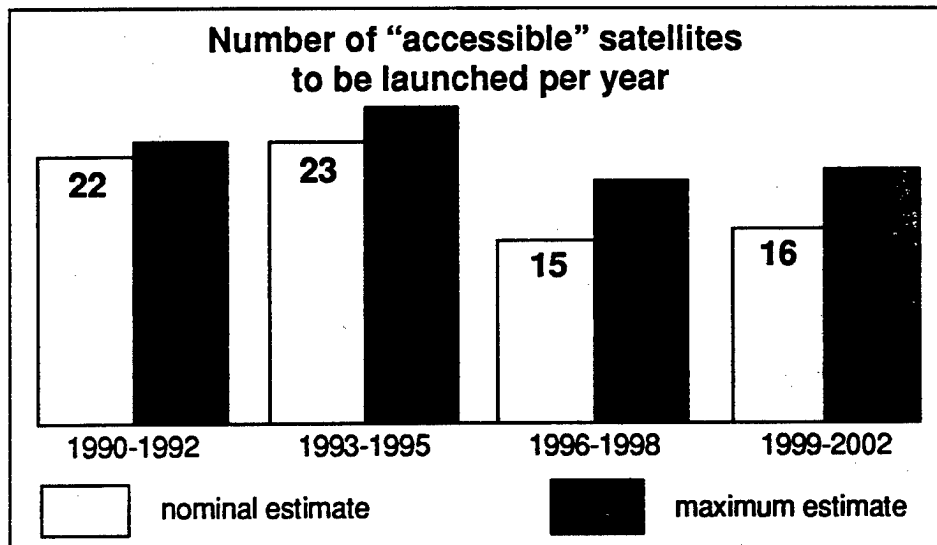
Our studies are used as the basis for a "nominal" estimate, i.e. the most realistic estimate whatever the changing conditions, and a "maximum" estimate, the figure which could be reached if all factors are optimum.

These two estimates are then weighted to take into account possible launch and spacecraft failures as well as the available launch capacity (supply) designed to satisfy the demand for satellite launches—itsself limited by production capacity.

The results indicate an upturn in demand in 1994-1995 due to the necessary renewal of the U.S. satellite network and the last phase of European network set-up.

From 1996 to 1998, needs will mainly be generated by other countries with a few new projects, and by the steady renewal of international systems. There will be limited U.S. and European requirements. The market will then return to its standard pace, with an average of 18 satellites to be launched per year.

In conclusion, the commercial market accessible to Arianespace, representing some 70-80 percent of the global commercial market, should pursue the development shown by the graph below.



#### **Airbus Industrie Studying Competitor for Boeing 747**

*91WS0210A Stuttgart FLUG REVUE in German  
Feb 91 p 50*

[Article by Volker K. Thomalla: "Flounder-Jumbo by Airbus?"]

[Text] Competition for the Boeing 747? An Airbus Industrie study looks at a super-jumbo for 600 to 800 passengers.

Among manufacturers of commercial airplanes, the Boeing Commercial Airplane Group undoubtedly takes the number one spot. The company which is headquartered in Seattle, Washington, owes this success primarily to the Boeing 747 whose popularity has not decreased although it has been on the market for 25 years. The 100th plane of the latest version, the 747-400, was delivered to Canadian Airlines in December 1990. Worldwide, a total of 800 jumbo jets are in the air, another 300 are on order.

In the area of short and medium-range airplanes, the European Airbus consortium has already taken a considerable market share away from Boeing. At present, it is assessing the chances of becoming a player in the profitable market for commercial jumbo jets as well. One study is looking at a giant airbus whose design is based on the A340 and which is able to transport 600 to 800 passengers over a distance of 13,000 kilometers (7,000 nm).

The plan is to equip this super-airbus with a flat, but extrawide fuselage whose shape would provide additional lift. This shape which resembles that of a flounder is said to improve aerodynamics and save fuel. The weight of the plane requires four large engines of the latest generation such as the Rolls-Royce Trent, the

GE90 or the PW4000 Growth. However, at present these engines are still either in the development or test stage.

Airbus president Jean Pierson confirmed that studies concerning the giant airplane were underway. At the air show in Farnborough the only information available was a picture of the plane. However, Pierson cautioned against too much optimism regarding quick implementation of the study. He said that a super-airbus would definitely not be available before the turn of the century. In any case, it would become reality only if the program made economic sense.

However, construction of another very unconventional giant airplane by Airbus Industrie has become a definite and realistic possibility. The plan is to replace the aging Supper Guppies which are flying airbus parts from all over Europe for final assembly to Toulouse with four considerably modified Airbus A300-600R models. Contrary to previous plans, the four basic planes will be new. Their cockpit section will be moved down to make room for two large loading gates above the cockpit which provide access to the interior of the humped fuselage. Vertical planes will be mounted to the outer ends of the horizontal tail unit to support the regular vertical rudder which provides too little lateral stability for the bulgy fuselage. The first development contracts are expected to be awarded by the end of 1991.

#### **First European Earth Remote Sensing Satellite Ready for Launch**

*91WS0210B Stuttgart FLUG REVUE in German  
Feb 91 pp 56-57*

[Article by Goetz Wange: "ERS-1 Looks Promising"]

[Text] The weather-independent European earth sensing satellite ERS-1 is ready to go. New antenna technology is expected to allow commercialization of its successors.

"Some of the parameters greatly exceed the requirements set by ESA, the agency which ordered the satellite," Alfred Setzer, project leader with system leader Dornier comments happily. With these results, the group of independent experts which came to Friedrichshafen last December was able to give the green light for the first European earth sensing satellite ERS-1. Any day now, the satellite will be transported by ship to French Guayana. The launch using an Ariane rocket is planned for May. The satellite will be placed into an orbit synchronous with the sun where it will fly over the poles at an altitude of 800 km.

The ERS-1 opens up a whole new chapter in earth sensing. The operational systems such as Landsat and SPOT use optical recording devices. In Central Europe with its frequent cloud cover their vision is blocked most of the time. The ERS-1, on the other hand, relies on active and passive radar devices which can record data in bad weather and during the night. Currently, little experience with such satellites is available. The American Seasat, for instance, stopped operations in 1978 106 days after its launch because of energy supply problems.

In the meantime, technology in this field has advanced considerably. Therefore, climate researchers in particular expect interesting insights from the ERS-1 mission particularly in the field of oceanography. After all, three quarters of the earth are covered by seas and oceans which harbor more energy than the atmosphere. In addition, the heat exchange between water and air is controlled by the expansion of the ice cover at the poles.

Mapping of the ice cover is done using a synthetic aperture radar (SAR), for which the satellite is carrying a ten meter long antenna which unfolds after the launch. It allows the capture of pictures with a resolution of 30 times 30 meters. An imaging radiometer (ATSR) will provide data on the surface temperature of our oceans. In addition, the ocean waves' height and direction of expansion will be derived from scatterometer and altimeter measurements. Even oceanic currents can be measured from the satellite.

ERS-1 data are also expected to improve short and medium-term weather forecasting which has been hampered by a lack of measuring stations above the open sea. The satellite will close this gap. The European center for medium-term weather forecasting in Reading, Great Britain, which prepares an eight-day forecast, shows great interest in the data. ESA project leader Reinhold Zobl is hopeful: "The ERS data will provide a more reliable basis for our computer models."

ERS-1 photos taken above land masses will provide useable information as well. An example is the mapping of the tropical rain forests. However, the interpretation of radar data to support the search for mineral resources is still more difficult than with optical systems. For future radar systems, a so-called multi-frequency radar might be a solution. While the ERS uses an antenna consisting of a single compact unit, the new system

would have an antenna composed of many small transmitter/receiver components which can be switched to different modulations. Laboratory research in this area looks very promising. However, up to now the enormous cost involved has prevented actual implementation. One possibility would be implementation as part of an international cooperation regarding verification satellites for which multi-frequency radars are also considered.

However, the second ERS will definitely not use this new system. It will have the same design as the first model of this series. The only addition will be a new ozone measuring instrument. While the ERS-1 including the new ground station in Kiruna cost 1.3 billion German marks [DM], the second unit will be billed at only around DM400 million, since the amount for this costly development has already been paid.

#### **EC: Space Station Logistics Vehicle Program Planned**

*91AN0341 Brussels ATHENA in French Feb 91 p 43*

[Text] A European manned space station project, the obvious follow-up to the Columbus project, is planned for 2005-2010 with the creation of the European Manned Space Infrastructure (EMSI). LOVE, the LOGistics Vehicle, is an automatic refueling and in-orbit relocation vessel with a concept similar to the Soviet Progress vehicle, which supplies the MIR complex. The European Space Agency (ESA) has just commissioned a preliminary study for LOVE (a contract worth ECU 200.000 or 8.6 million Belgian francs) from an industrial team directed by Aerospatiale and comprising British Aerospace and the Brussels-based company Space Applications Services.

The Soviets will be associated indirectly with this study for ESA. Aerospatiale has signed a collaboration agreement with NPO Energiya in Kaliningrad to examine different types of systems for space logistics. NPO Energiya is considered to be the most important Soviet space industry division: It is responsible for the development of all manned space vessels in the USSR, notably the modules for the MIR space station.

#### **French Firm Presents Light-Weight Aircraft Propeller**

*91AN0307 Toddington NEW MATERIALS INFORMATION in English Mar 91 p 2*

[Article: "France: Kevlar Saves Weight, Raises Impact Role"]

[Text] What is claimed to be the world's largest composite aircraft propeller is 50 percent lighter than a traditional metal design thanks to the use of a hybrid reinforcing fabric of Kevlar, carbon and glass fibre.

According to propeller manufacturer Ratier-Figeac, a 500 kg weight saving has been achieved in twin-engined transport aircraft with propellers measuring over five

metres in diameter. The weight reduction offers improved fuel economy and manoeuvrability.

Each blade of the propeller has a sandwich structure that consists of a foam covered on each side by a resin-impregnated laminate of Kevlar, carbon and glass fibre. This sandwich construction achieves a high strength to weight ratio. Du Pont's para-aramid fibre provides vital resistance to damage and impact; the composite propeller is also easy to repair, a further advantage over traditional metal designs.

Ratier-Figeac has developed the new propeller especially for the C160 Transall troop carrier of the French Army, which can land on small airfields. The company now seeks to capture the civilian commuter aircraft market with specially designed all-composite propellers.

### Germany's HYTEX Scouting Out Space Transporter Technologies

91WS0282B Stuttgart FLUG REVUE in German Apr 91 pp 70-74

[Article by Michael K. E. Hauger: "Peak Values"; first paragraph is FLUG REVUE introduction]

[Text] It is difficult to reach space with an aircraft, but maybe it is possible with two. At least that is what is envisioned in the Saenger concept, which at present is being studied in Germany. Particularly demanding technically is the first stage, equipped with ram jet engines. Wind tunnel studies are not sufficient for this. That is why HYTEX, a special experimental vehicle, is to be used for test flights in Europe.

Since 1988 the foundations for a horizontal-takeoff, reusable space vehicle have been worked out in the FRG within the framework of the Hypersonic Technology development concept initiated by the Federal Ministry for Research and Technology (BMFT). With the two-stage Saenger concept proposed by MBB [Messerschmitt-Boelkow-Blohm], the leading position at the moment in the development of a potential space transporter system of the future is to be expanded. It is then hoped that with the developed capabilities for system leadership it will be possible take over technologically interesting and demanding portions of the work in an international cooperation project. For one thing can already be seen today: It will only be possible to tackle the technological (as well as financial) challenges of hypersonic flight in multinational cooperation. And yet another curious fact characterizes the ambitious project: It could become the life work of many young engineers, for while it is anticipated that the first flight of the Saenger will not take place until between 2005 and 2010, the test phase of the system will require another 15 years.

In addition to concept studies for the Saenger and its propulsion system, the construction and propulsion of an experimental aircraft named HYTEX which uses hypersonic technology has also been a component of the

technology program from the beginning. The first flight of HYTEX is set for 1998 after an eight-year development period.

In developing the key technologies needed for the Saenger in the fields of propulsion, materials, construction methods, flight mechanics and control, as well as aerodynamics, the specific problems of hypersonic flight is setting the limits for pure testing on the ground. In addition to a general demonstration of the feasibility of hypersonic flight, HYTEX is primarily to prove the Saenger concept. By demonstrating the technologies used, it is also possible to reduce the development risk and thus minimize the overall development costs.

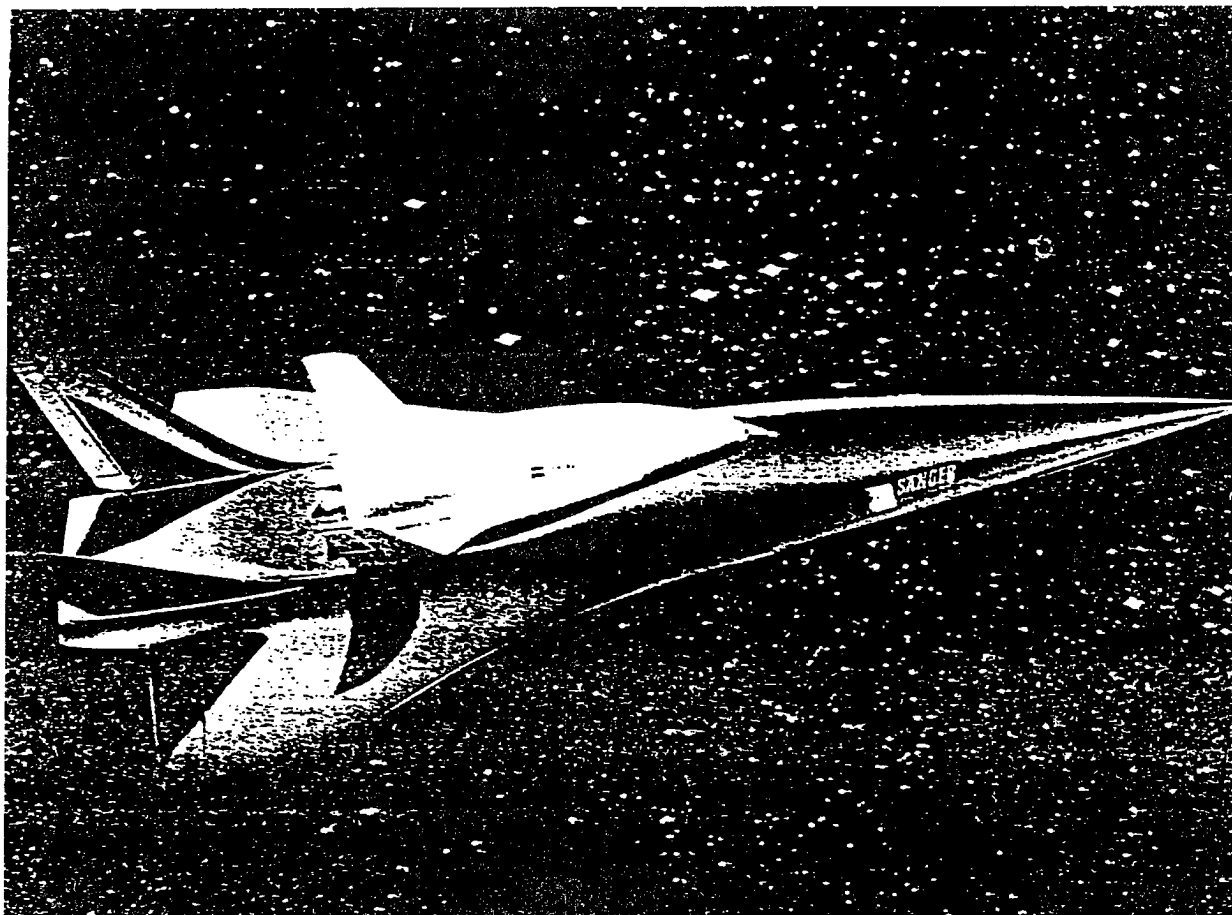
The latter applies in particular to the propulsion system, which is completely integrated into the tail. The function of this system must be demonstrated under all flying conditions. Studies have indicated that only 15 percent of the verification of the propulsion system can be carried out on the ground, but an additional 75 percent will be the result of flight tests with HYTEX, so that only one-tenth of the development risk remains for the Saenger propulsion.

### Almost No Similarity With the Saenger First Stage

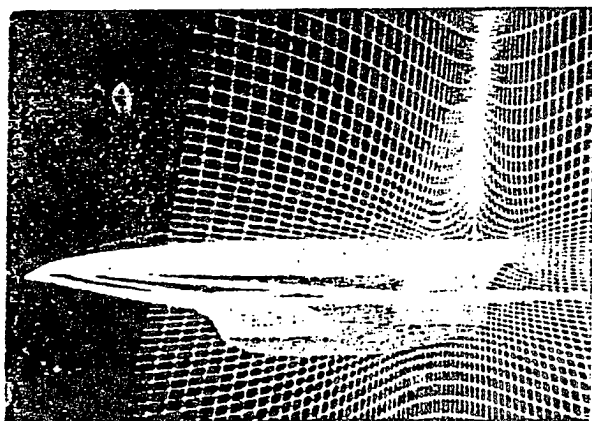
While for the Concorde's flying speed of Mach 2 the power plants can be conventionally arranged under the carrying surfaces, for the SR-71 (Mach 3.5) they must already be integrated into the airfoil. For the lower stage of Saenger, which has a flight Mach number of 6.8 the power plant must be integrated into the airframe in an expensive interdisciplinary design process. The forces and moments occurring at the intake and jet in this design many times exceed the weight, resistance and lift of the airframe and require a new type of flight control. At high flight Mach numbers the usual rudders and flaps are of only limited use, and the stability and steerability of the aircraft can presumably only be guaranteed by thrust-vector control.

A further key problem is hypersonic aerothermodynamics. For example, the resistance during the transition from laminar to turbulent flow increases 30 percent. Materials and structure are under extreme stress and must also be designed for maximum temperatures and force loadings. Continuous loads of 1,482 degrees C and five tons per square meter, such as occur in HYTEX's subsonic diffuser, present the materials technicians with major challenges, because until now the materials commonly used in aeronautics have a "threshold of pain" at about 500 degrees; up to about 1,200 degrees titanium superalloys can be used, but beyond that until today only ceramics are usable.

In addition to the "known unknowns," however, the so-called "unknown unknowns" are making flight testing with HYTEX indispensable. For example, in the U.S. X-1 the reversal of the rudder effect was observed for the first time in the transsonic area, and in hypersonic flight the X-15 completely unexpectedly began to spin. The experimental aircraft with hypersonic technology must



For the Saenger transportation system (large picture), the first stage will separate from the orbiter at 31 km altitude. The HYTEX demonstrator is to yield information about hypersonic flight.

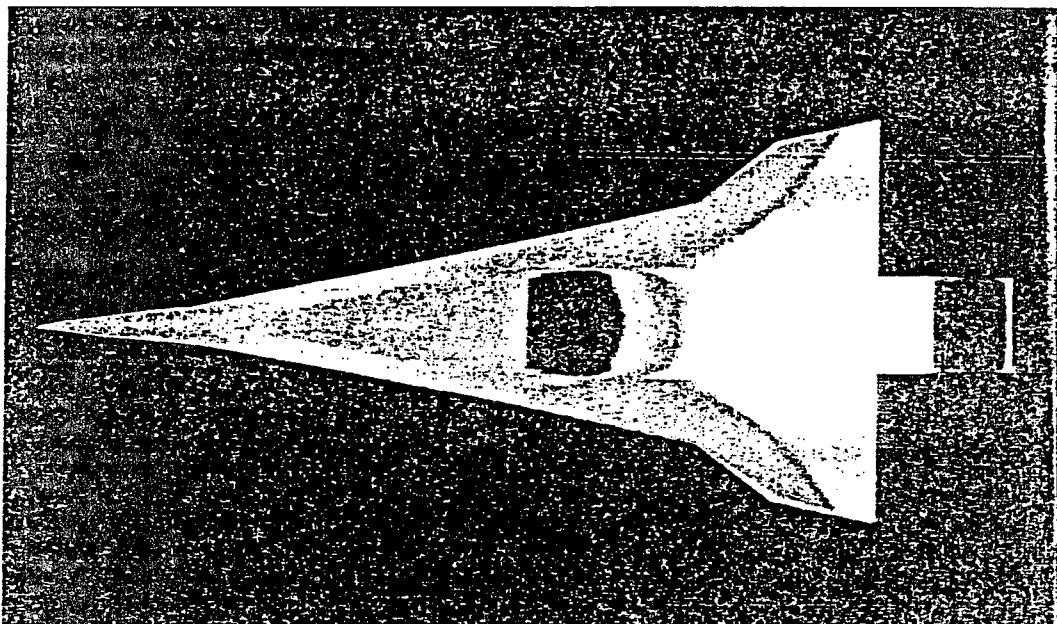


Preliminary work is already under way on the Saenger in the supercomputer: In a numerical simulation, the upper surface of the HYTEX configuration is shown through a mesh grid and the spatial flow field is represented.

therefore deliver the data needed to confirm the aerodynamic design tools and verify the assumed structural heat loads, stresses, forces and moments. Equally interesting at the very least is exchanging and testing structural components. This possibility is particularly important for the high-load regions of the power plant inlet and the jet, for the leading edges of the wings and the actuators.

With its air-breathing propulsion, HYTEX will research a previously totally unknown field: The X-10 with a turbojet engine reached a flight Mach number of 2 for the first time; Mach 7 was reached with the exclusively rocket-powered X-15. The engineers are hoping with similarly high anxiety for confirmation of their predictions for the behavior of inlet, power plant and jet. The focus of this is the transition from turbo to ram jet at a flight Mach number of 2.9 and, above all, the until now completely unknown ram jet operation with liquid hydrogen.

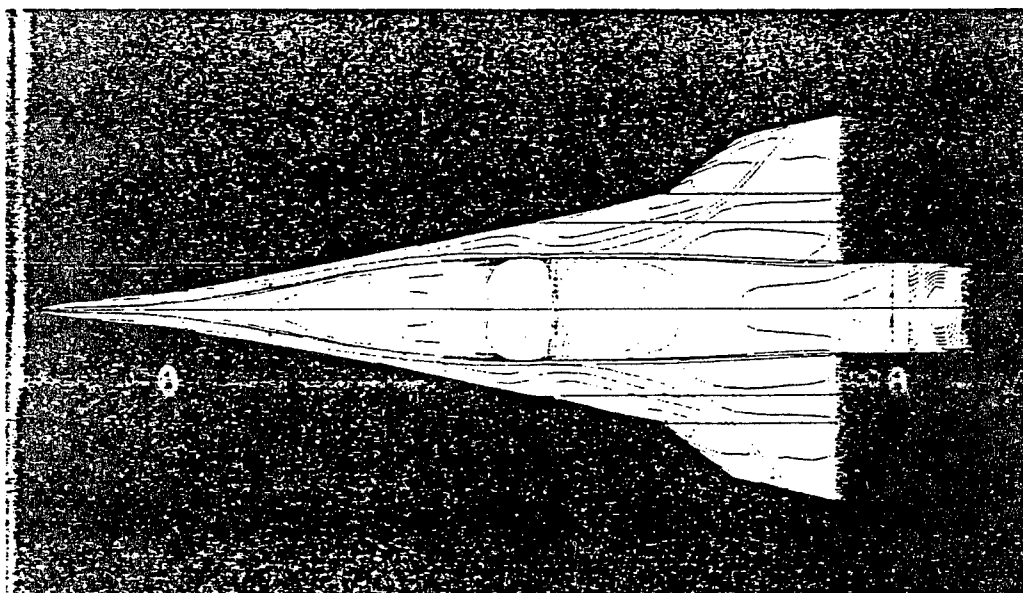
In all of the technological challenges, HYTEX, like every other experimental aircraft, is aimed at the most



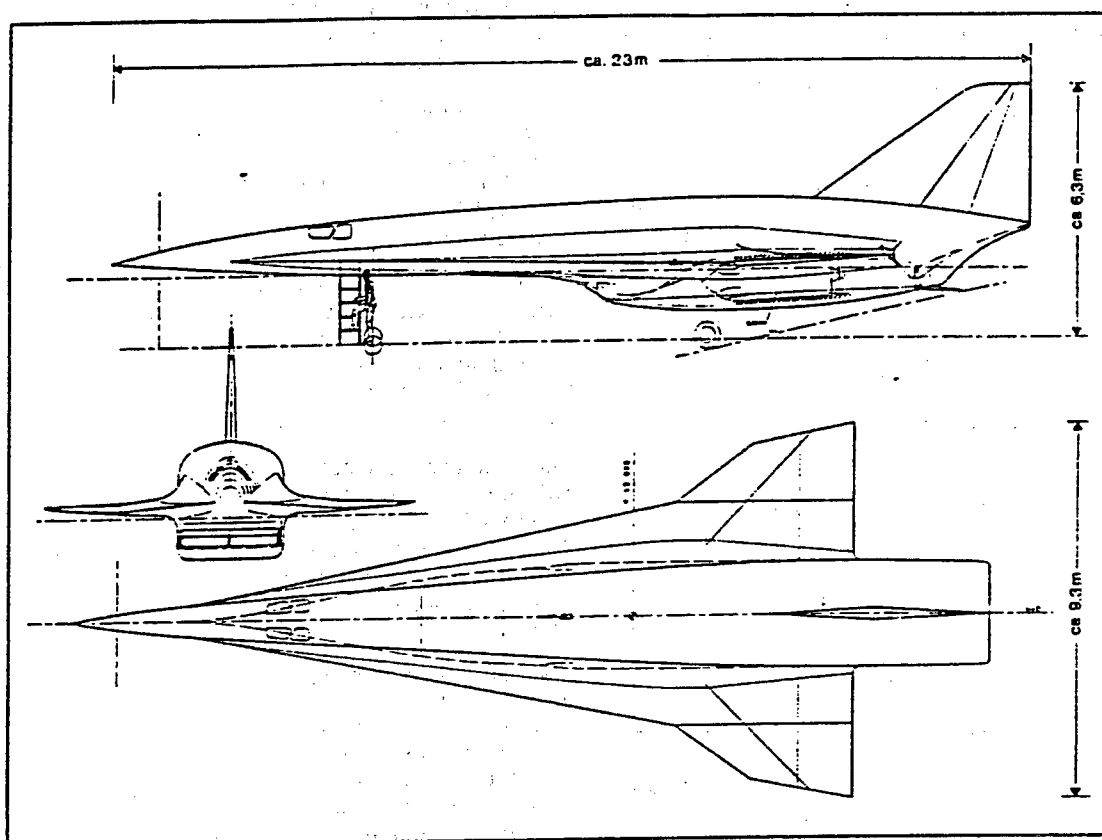
economical research of previously unknown technologies and is intended to confirm assumed circumstances. For instance, the power plant is operated with a combination of kerosene and liquid hydrogen, because operating a turbojet engine with liquid hydrogen is no longer a problem today. HYTEX will—although its external dimensions (23 m length, 9.3 m width, 6.3 m height) may lead one to assume so—not

be a mini- Saenger on a 1:4 scale, but 85 percent of it will consist of level, developable surfaces. Geometric similarity is not necessary for a similarity of phenomena.

The HYTEX will fly manned, be able to take off and land horizontally in Europe and be 100 percent reusable. The integrated single-flow turbojet and ram jet power plant (serially arranged) with a two-dimensional jet will



Simulation in the supercomputer supplements the wind tunnel tests: Important knowledge of whether the HYTEX demonstrator is flyable is given by calculation of the pressure distribution. By means of colors it is already shown on the screen where critical values are reached on the underside of the configuration. Red signals problem zones, blue shows low values (center lower row of images [not reproduced]). Another form of representation using lines for constant values shows the data. The wind tunnels available in Europe are only conditionally suitable for experimental control tests.



In comparison, the measurements of the HYTEX demonstrator are rather modest, because Saenger's lower stage is to have a length of 81 m and a wingspan of 41 m.

be used in concentric construction. It uses the afterburner chamber of the turbojet engine as a ram combustion chamber, but has the disadvantage of a considerable need for control in the intake area and makes a jet with thrust vector control necessary. As the turbojet power plant a modified engine from the high-performance aircraft industry (such as EJ 200) will be used.

#### Cooperation Arranged With Sweden

For the Saenger it will be necessary to start new development even from the aspect of the required performance alone. Although the HYTEX engine configuration has now been decided, for the power plant concept of the Saenger's first stage four different configurations are still being studied. The power plant concept that turns out to be the most suitable and efficient will not be picked until later.

The flight profile of the experimental aircraft is similar to that of the Saenger. During a 50-minute flight at a peak speed of 28 km [sic] the maximum flight Mach number of 5.6 to 6 will only be reached for one minute, and the ram pressure will rise to 70 kPa. This short time in a flight condition with maximum power plant load is sufficient for the power plant to reach the state of equilibrium necessary for measurements. For the

Saenger there follows the separation of the rocket-propelled upper stage at not quite Mach 7 at 31 km altitude.

Deutsche Aerospace, which with its subsidiaries Dornier, MBB and MTU [Motoren- und Turbinen-Union, GmbH] is the leading company in the Saenger project, recently obtained an additional boost for its planned altitude flights: The Federal Ministry for Research and Technology (BMFT) and the Swedish National Space Board (SNSB) signed an agreement in Bonn for cooperation on the hypersonic technology program. This is the first time an international cooperation within the framework of this BMFT program has been formalized. Contacts are already under way with other European countries such as Great Britain, the Netherlands, Belgium, Spain, Switzerland, and Austria; the cooperation talks with Norway and Italy are about to be concluded. At the end of the "Moscow Aerospace" exhibition there were contacts with Soviet companies and research establishments, and feelers have also been extended towards Australia and the United States.

The only question that remains is the one of French partners: The French, it was said in connection with a talk given by Dr. Sacher, HYTEX project leader at MBB,

within the framework of the Colloquium of the Aerospace Department of Stuttgart University, only began to discuss hypersonics a year ago and for that reason do not yet today have any precisely defined concepts. Even so, it is expected that constructive negotiations for cooperation will be held with France as well.

With an intended payload ratio of 29.8 percent, which roughly corresponds to that of the Boeing 747 (fuel: 30 percent, equipment: 6 percent, power plant systems: 11 percent, structure: 23.2 percent) and which is impossible to achieve for a one-stage space transporter, one is favorably positioned initially for any such talks. But: There is certainty even today that France will try to impose a French stamp on the Saenger project. "Perhaps the Saenger could one day be called the Chanteur," speculates MBB man Dr. Sache.

### **German Researchers Develop Transputer-Based Cockpit Displays**

*91WS0324A Bonn DIE WELT in German  
18 Mar 91 p 9*

[Article by: Jochen Neidhardt: "The Monitors in the Cockpit Are Becoming More Flexible"]

[Text] Computers have had entree in aviation technology for a long time already. However, when it is a matter of the representation of rough images, the possibilities of modern computer systems have not yet been exhausted. A new "transputer system" will provide pilots with a still better representation of important flight data.

Precise and swift pilot information on current flight data is without doubt of very great importance. A computer-based representation of data would appear to be an up-to-date solution, but so far it has lacked a suitable graphics system that could present charts and diagrams with sufficient speed. Many data continue to be, as before, visualized by means of mechanical indicators.

Researchers at the Braunschweig Technical University have now succeeded in developing a graphics system, by means of which displays can be dynamically compiled for the pilots during the flight. By utilizing the enormous computing power of several microprocessors connected in parallel—so-called transputers—it has now become possible to represent rough images with sufficient precision in the cockpit of the aircraft. Combined with satellite-based navigation and a digital charts data base, map representations, for example, can be produced in the cockpit in real time.

The "picture quality" of the computer-based representations in the cockpit must satisfy the highest requirements. Instead of the usual pixel graphics, also known in PCs, so-called vector tubes, which have exceptionally good representational quality, are exclusively employed in aircraft. The disadvantage is, however, that conversion of image information on the screen is a very

complicated process. Time-consuming analog guidance of a vector tube has not yet permitted the representation of rough images.

One was limited to solidly programmed image representations—for instance, by "classical instruments." Changes were only possible after quite a high expenditure of time, so that their use in an aircraft cockpit still remained limited to a few, established representations like the compass rose or artificial horizon.

At first, the Braunschweig researchers failed when they wanted to integrate an additional warning indicator based on this kind of cathode ray tube. But instead of building another, expensive but unchanged representation with the new display, they developed a new flexible graphics system for vector tubes.

The researchers divided the viewing screen into 1024 x 1024 points, which then served as the working basis for a so-called vector generator. The generator converts the digital value of the graphics system on the point screen into analog voltages for the vector tubes. In this way, representations on the basis of digital number values become possible.

The new system is being currently tested in an experimental aircraft. Five high-grade processors, working in parallel, are constantly at work during the flight in order to make video signals available to the vector generator. Only four of processors compute the representation from the navigational data and charts data base provided from the aircraft computer. The representation is, appropriate to the display instrument, "vector-oriented." Consequently, it contains only the essential data, which were extracted from a normal aeronautical chart before storage. This time-consuming process would—in the case of a pixel-oriented memory—be necessary during representation, which is to say, in flight. This is even too time-consuming in parallel data processing.

With a surprising capability for parallel processing, the transputer manages the data transmission to the cockpit over a distance of 15 meters, while simultaneously computing new data, without any problems. The chart to be represented is determined by the graphics system on the basis of the current flight position. It is precisely determined by the aircraft computer by means of a satellite-based navigational and guidance system, regardless of weather, to the decimeter. "While representations from instruments to date have been given statically, now, for the first time in chart display, the image content is configured dynamically," one of the developers, Klaus Bavendiek, emphasized.

And the chart representation is only one special application for the Braunschweig graphics system. It is important that it builds a technological bridge between pixel and vector graphics. On the principle of the least common denominator, the researchers built their system on an instruction set, which is common to both graphic modes, and builds on the point screen. In this way, new representations for vector tubes, as for instance certain

warning displays, are now also being developed pixel-oriented. It is possible in economical, commercial graphics stations in a powerful programming language. Thus, new special displays are being developed within a few weeks, while previously one would have to wait several man-years for such developments.

### Italian, Soviet Aerospace Agreements Signed

#### Experimental Satellite Links

91MI0287A Rome AIR PRESS in Italian  
27 Mar 91 p 708

[Text] The IRI [Institute for the Reconstruction of Industry] telecommunications holding company will begin collaborating with the Soviet company Astra to set up experimental satellite links between Italy and the USSR. The Soviet Raduga telecommunications satellites will be used for the connections as will specially modified earth stations. This program falls under the framework of the USSR's reconversion of military activities to civil applications.

#### Remote Sensing

91MI0287B Rome SPAZIO INFORMAZIONI  
in Italian 3 Apr 91 pp 3-4

[Text] Telespazio and the Soviet company Agroresources have recently stipulated a technical and scientific collaboration agreement to carry out joint projects in the agricultural sector by using advanced, remote sensing technologies via satellite. "The agreement," Telespazio stated, "will create a synergy between the high-level, international know-how and experience acquired by the two companies in this specific sector, in order to handle major problems such as the development and monitoring of agricultural resources." Agroresources director, cosmonaut Pavel Popovich, came to Rome to sign the agreement. "The objective of this visit to Italy," Popovich told SPAZIO INFORMAZIONI, "was to draw up the contract. The goal is for the agricultural reform of the USSR's land register. Telespazio has a great deal of experience in these problems and this will be of great help to our country."

### Italy: Italian Delegation to ESA Conference Interviewed

#### Italian Space Agency President

91MI0225A Rome SPAZIO INFORMAZIONI  
in Italian 6-13 Feb 91 pp 2-5

[Interview with Luciano Guerriero, president of the Italian Space Agency by SPAZIO INFORMAZIONI at Santa Margherita Ligure; first paragraph is SPAZIO INFORMAZIONI introduction]

[Text] Hard times are ahead for "Europe in space." Space activities are feeling the repercussions of the recent events that have begun to change the geopolitical

scene of the Old World together with all their possible economic implications. These events are unfortunately creating doubts and uncertainties as to the real possibility of respecting ESA (European Space Agency) commitments and programs, and have led to a joint call for a new ESA conference at the ministerial level to examine the decisions made in Rome in 1985 and at the Hague in 1987 in light of new needs and expectations. In preparation for this important meeting (which according to some sources might be held in Germany next autumn), the ESA recently held an extraordinary meeting of its council at Santa Margherita Ligure in Italy, to give the executive committee an opportunity to present a preliminary proposal to revise the long-term plan to all the national delegations. Little is known about the actual contents of this proposal that nevertheless deals primarily with problems concerning projects for the so-called "European space infrastructure": the two pressurized Columbus modules (the Columbus Attached Laboratory and the Columbus Free Flying Laboratory), and the DRS (Data Relay Satellite Communications System) and the Hermes space shuttle. However, discussions on these topics during the Liguria meeting certainly triggered off a complex mechanism of modification and investigation by the ESA's executive committee. So much so that the president of the council himself, Professor Francesco Carassa informed SPAZIO INFORMAZIONI of his forthcoming trip to Paris "for further meetings and talks." In fact a new meeting of the council largely dedicated to problems concerning the revision of the long-term plan and the ministerial meeting is scheduled to be held precisely in Paris on 20 and 21 March. SPAZIO INFORMAZIONI interviewed the head of the Italian ESA delegation and president of ASI (Italian Space Agency), Professor Luciano Guerriero, about these controversial problems and the results of the meeting in Santa Margherita. The text of the interview follows below.

**SPAZIO INFORMAZIONI:** What were the topics and goals of the recent ESA council meeting in Italy?

**GUERRIERO:** It was a preliminary meeting where the ESA executive council attempted to present a basic proposal to revise the long-term plan after consultations with the various delegations. This is what we discussed. Of course, other meetings will be necessary before we find a formula that will meet with the consensus of all the ESA countries.

**SPAZIO INFORMAZIONI:** The urgent need to deal with the problem of funding European space activities has been emphasized by many however. What is your opinion?

**GUERRIERO:** A financial problem certainly does exist. In fact, the German delegation pointed out that their government has requested a significant reduction in German funding. And Germany also hopes that this would mean a reduction in Europe's annual commitment to space infrastructures over the next few years. However, this has yet to be decided. In fact, the situation

we are currently examining comes four years after the decisions made at the Hague and permits an analysis to be made in the light of numerous technical results and international events. This will enable us to draw up a far more realistic long-term plan for space infrastructures than was possible in 1987.

**SPAZIO INFORMAZIONI:** There is talk of rescheduling execution times for space infrastructure programs.

**GUERRIERO:** No results or decisions emerged from the meeting. What was examined was a first draft proposal from the ESA executive committee. Given the situation and recent discussions with NASA over the Freedom international space station, and the problems that were identified with existing European programs, some parts of the infrastructure program may need to be carried out in the short term, based on deadlines that are very similar to those previously projected. Other parts will probably be completed after the original deadlines, both for budget reasons, development schedules, technologies to be developed, and consistency with NASA programs.

**SPAZIO INFORMAZIONI:** In this context, what stand did the Italian delegation take at the council meeting?

**GUERRIERO:** My personal opinion is that the long-term plan should not be revised by starting with a budget cut, because this is clearly a negative way of seeing things. Instead it should be revised realistically by analyzing which is the most intelligent and rational form of planning—at the technical and programming level and in relation to ties with NASA and other structures in the world—in order to keep up with the strategic decision made at the Hague to achieve European autonomy through a phase of intense collaboration with the United States. We must therefore determine whether this new schedule, which has been realistically defined by taking into account all the outside determining factors, is compatible with the available funding. Since these difficult and demanding programs tend to be long-term ones, the proper rescheduling of this space activity may automatically lead to the reduction the Germans are asking for and also appeal to other countries because financial problems are common to almost all European countries.

Nevertheless, the Italian delegation considers the plan prepared by the ESA executive committee to be a first draft and not the final result that has been agreed upon. At any rate, it is a good starting point. In particular, our delegation can identify itself with this plan because both the DRS and the Columbus Attached Laboratory module are short-term projects, and because the ESA is interested in the bilateral initiative involving the logistic module that Italy is attempting to start with NASA.

**SPAZIO INFORMAZIONI:** So, would programs such as the Columbus Free Flying Laboratory and Hermes be even more penalized?

**GUERRIERO:** Well, it is not really a matter of being penalized, but their schedules would be realistic in view of the technological and systems problems that these

programs entail. Of course, if the plan is defined with a schedule that differs from the 1987 projections, everything will obviously have to be acceptable and coherent for all the participating countries. For example, certain projections involving the distribution of industrial roles, which were valid for the simultaneous construction of the two pressurized Columbus modules over the same time frame, will have to be modified if either one or the other schedule is anticipated or extended. We need to be quite realistic and very honest, in the sense that no one should try to be smart and say: "I am cutting my budget, and I think that the others are stupid because they are paying for something that will benefit another country." We are all adults and should therefore say: "I am paying and I expect my role to be respected and recognized; I also expect to receive due returns in terms of quality and quantity. But I must demand this and obtain this for everyone, and work accordingly." This is the only way to build up Europe. The French must understand this, as must the Germans, and even Italy must be consistent with this principle.

**SPAZIO INFORMAZIONI:** Do you think that the current time is the most delicate that "Europe in space" has had to face since the establishment of the ESA in 1975?

**GUERRIERO:** This is a very delicate time. I am not saying that it is a dangerous moment, but it is definitely a period that needs to be observed with great attention for various reasons. First, various European countries are going through difficult economic times and we must therefore be very careful not to lose track of the political aspect of space initiatives. There are several ways to cut a country's budget. We must not lose sight of the fact that the infrastructure we are building - and which must play a worldwide role along with the United States, the USSR, and Japan - cannot allow itself to be in a situation in which it is not independent. Certain decisions made at the Hague therefore need to be confirmed, primarily because of their political nature. Of course, these decisions must not be just wishful thinking, and, I am referring both to the budget and the technical schedules which lead to the development of certain skills. The second reason is also very important: the ESA is a structure that has anticipated Europe, today we could even argue whether space flights should be handled by the ESA or by the European Community! This is very dangerous, because the fact that Europe has a European Space Agency shows that it has moved exceptionally fast in a certain sector, catching up with historical delays. We should try, therefore, to never put a stop to mechanisms that are working well. Third: Europe is opening out to East European countries, which have already shown an interest in approaching the ESA. So, the problem of expansion will probably need to be faced. Thus in the future, the ESA will probably find itself in a situation where some countries will have a considerable participation and others will have more marginal participation. On the other hand, a significant part of ESA programs are optional programs, where there is no division among

countries on the basis of GNP but a free choice on the basis of interest. The mechanisms themselves that were once tested in the ESA's decision-making processes when it was established - when it had a completely different planning structure - should now be reviewed. Otherwise, we may find ourselves with difficult processes to cope with. We need to have the courage to review these problems. We are therefore in a very critical phase, because the ESA is changing as a structure, in terms of distribution of optional and obligatory programs, and we are also at a critical point in European evolution. We started this process of European emancipation in space, and all this should be taken into consideration.

**SPAZIO INFORMAZIONI:** How will Italy appear at the ESA's next ministerial meeting?

**GUERRIERO:** It is very dangerous to go to a ministerial meeting with the intention of "making cuts." Instead, the intention should be to confirm European policy decisions, optimize schedules so that the programs can be carried out realistically, and attempt to exploit all the investments made in this sector to the utmost. This is the position that Italy will have to defend.

#### ESA Council President

91MI0225B Rome SPAZIO INFORMAZIONI  
in Italian 27 Feb 91 pp 2-4

[Interview with Francesco Carassa, president of the European Space Agency Council by SPAZIO INFORMAZIONI at Santa Margherita Ligure; first two paragraphs are SPAZIO INFORMAZIONI introduction]

[Text] Will financial problems put a stop to the development of European space activities now that the Old World is moving toward its long-awaited independence in complex space missions? This is perhaps the most distressing question echoing through the crowded halls of ESA headquarters in Paris. So much so that the protagonists most directly involved in the future of "Europe in space,"—that is the heads of the various national delegations at the ESA council's periodical meetings—decided to meet in Italy in Santa Margherita Ligure, almost as if they were looking for neutral ground without the usual formal restrictions. After having set aside protocol and bureaucracy for once, the representatives of the European countries were able to exchange ideas freely, formulate proposals and solutions, and calmly examine the ESA executive committee's proposal to revise the long-term plan. It was an unprecedented decision that bears witness to the delicate times that European space activities are preparing to face. This was confirmed by the head of the Italian delegation and president of the ASI, Professor Luciano Guerrieri. The ESA instead officially prefers discretion and privacy.

SPAZIO INFORMAZIONI nevertheless called on the president of the council, Professor Francesco Carassa, who promoted the recent meeting in Liguria. The text of the interview follows below.

**SPAZIO INFORMAZIONI:** What were the objectives and actual results of the Santa Margherita meeting?

**Carassa:** When I proposed organizing this informal meeting at Santa Margherita to the ESA council, my intention was to offer the various delegations a chance to sit at a round table and openly express their own ideas, without the restrictions normally present in meetings where decisions, and consequently, official positions must be taken. This idea was put into practice, to the point that the minutes of the meeting were not drawn up. I cannot say much on the opinions that were expressed, beyond some personal feelings. The main issue was the next ministerial meeting of the council likely to be held in autumn, the follow-up to the meetings held in Rome in 1985 and at the Hague in 1987. The decision to organize this ministerial meeting is linked to the changes that have taken place in both the political scene and the space sector since 1987. On the other hand, the most demanding programs today contain many more elements than in the past to establish precise policies. In fact, someone made the observation that intentions were expressed in 1985, the general lines to pursue those intentions were expressed in 1987, and that the projects will have to be well defined in 1991. These projects must be compatible with the desires of the various countries and the funding that they intend to provide, especially for the optional programs that are the most financially demanding. I am referring to programs which concern space infrastructures and transport in particular, programs which among other things, aim at giving Europe an independent operating capacity in the field of the human exploration of space.

This basically involves putting together the lines of a coherent program, which meets the requirements I mentioned, and which can serve as a point of discussion at the ministerial meeting. At its meeting last December, the council created a work group to prepare for this ministerial meeting. This group will meet soon, and it is expected to work very quickly, keeping in constant contact with the council. Of course, it is obvious that the political aspects are just as fundamental as the technical features, so continued action will be required at this level.

**SPAZIO INFORMAZIONI:** Briefly speaking, what were the tendencies of the various national delegations at the meeting in Italy?

**Carassa:** It seems to me that an agreement exists on the goals set at the last ministerial conference at the Hague. So, we need to reexamine that approach by taking into account our greater expertise, the priorities and needs of the various delegations, and the conditions under which the countries intend to provide funding. In this case, the main role obviously falls upon the countries making the largest contribution, especially France, Germany, and Italy.

**SPAZIO INFORMAZIONI:** According to many observers, however, the main problem would appear to be funding. What do you think? What are the possible solutions?

**Carassa:** It is very difficult for me to say anything about this issue at this time, because we must see what the next developments are. There is certainly a chance that the programs will be extended over time, and of course, reviewed a certain degree—and I think this will occur. However, I can neither express an optimistic nor a pessimistic opinion at this point, because these issues have only just been brought up.

**SPAZIO INFORMAZIONI:** There was talk of extending some programs for even a few years.

**Carassa:** I cannot comment on this issue, because talks are absolutely at a preliminary stage; they are just starting now. So as president of the council, I cannot say anything. I can only say that the executive committee has already drawn up a study that will be a basis for discussion, but cannot say anything about this.

**SPAZIO INFORMAZIONI:** At any rate, how do you judge the proposal to revise the long-term plan drawn up by the ESA's executive committee?

**Carassa:** It certainly seems to be an interesting step. However, we must still proceed with a more in-depth comparison with what the delegations are willing to do, on the basis of interests and restrictions, even financial ones. This is an open question.

**SPAZIO INFORMAZIONI:** Will you be talking about these issues at the council on 20 and 21 March in Paris?

**Carassa:** I think it is still too early to think about making a decision on this during the March council, even if a preliminary report is going to be presented by the work group. I believe that the council's important meeting will be this June.

**SPAZIO INFORMAZIONI:** In your opinion, is this the most difficult period that the ESA has faced since its establishment?

**Carassa:** Oh goodness, that is a million dollar question! I would like to answer that question in a few months because it is hard to say anything at the moment. In my opinion, the ESA had identity problems in the distant past and even they were not small. I think that the goals we wish to reach today are rather clear. The problem is therefore quantifying them to satisfy everyone. It seems to me, however, that in general the goals proposed at the Hague are still valid, and pretty much shared by everyone. The problem now is to determine what we can actually do.

### **Italy: Conference on Columbus Precursor Flights Summarized**

*91MI0246 Rome SPAZIO INFORMAZIONI in Italian  
20 Feb 91 pp 2-3*

[Text] The ASI (Italian Space Agency) is planning to allocate about 100-120 billion lire during the new 1990-94 five-year NSP (National Space Plan)—which is still being evaluated by the Ministry of Universities prior to its transmittal to CIPE [Interministerial Committee for Economic Planning]—to participate in the ESA's (European Space Agency) activities concerning the so-called Columbus Precursor Flights. Such activities hinge, in particular, on the EURECA-2 [European Retrievable Carrier] and EURECA-3 missions, scheduled for 1994 and 1996 respectively, and the Spacelab E-1 and Spacelab E-2 pressurized laboratories scheduled for 1994 and 1996-97. This was made known in Rome a few days ago, at a national workshop on the Columbus Precursor Flights, organized by the ASI. Attending the workshop were, among others, ASI president, Professor Luciano Guerriero, president of the ASI's scientific committee, Professor Remo Ruffini, an expert from the ESA's Microgravity and Columbus Utilization Department, Dr. Peters, and numerous representatives of scientific institutes and companies, such as the Universities of Rome, Bologna, Genoa, Trento, Pisa, Parma, Milan, Ancona, Florence, Sassari, Naples, Padua, Trieste, Catania, Turin, and Calabria, the Milan Polytechnic, several CNR [National Research Council] institutes (including ICFAM, TESRE, IFSI, IAS, IFCAI), the MARS center, CARSO [Center for Advanced Research on Space Optics], CORISTA [Consortium for the Research and Development of Advanced Remote Sensors], ENEA [Italian Committee for R&D of Nuclear and Alternative Energies], Alenia Spazio, Officine Galileo, Laben, Ansaldo, CISE [Center for Data, Studies, and Experimentation], Tecnospazio, Alitalia, Proel Technologie, Elettronica, Elsag, Carlo Gavazzi Space and, representing the armed forces, the Rome School of Aeronautical Medicine and the DASRS (Air Studies, Research and Experiments Division) of the Pratica di Mare airport near Rome. "The event was very successful both in promoting the initiative and in answering the queries raised by the scientific community," said Eng. Giovanni Rum, workshop coordinator. He also noted that, following ESA's call for proposals and ideas for new experiments to be carried on the Eureka and Spacelab missions, the ASI had forwarded 60 "notifications of interest" (essentially, in the areas of materials and fluid sciences, and life sciences), and at least 20 more were about to be sent. Speakers at the meeting also revealed that, as far as the Spacelab missions are concerned, the ASI has assumed as a working hypothesis the possibility of drawing on additional government funding, to supplement the participation that has already been established within the ESA. The ASI, in fact, is seeking to create a basis for significant Italian involvement in the microgravity experiments on space flights, both by widening the community of scientific and industrial users and by

developing specific support infrastructures on a nationwide basis. In this context, ASI experts maintain that the sources of funding should be identified on the basis of the various cost categories that are associated with the preparation and implementation of the missions, investments by industry being considered as well. As for the initiatives that the ASI has already launched or is about to undertake in this sector, the following points were emphasized: 1) a group that will coordinate all the activities connected with these missions has been established to promote the initiative, provide prospective users with support and guidance in the preparation of the proposals, and ensure coordination with the ESA and the other national agencies; 2) the distribution lists of ESA's "call for proposals and ideas" have been reviewed and updated to include roughly 50 new addressees in Italy; 3) the ASI intends to assess the Italian proposals, to ensure effective cooperation with the ESA and with the other national agencies during the selection process; 4) the ASI will consider whether to develop instruments and multiuser facilities to be used in this precursor flight program; 5) the ASI will select the experiments that will eventually receive funding for the Spacelab missions. Finally, in reply to a specific question raised by SPAZIO INFORMAZIONI, Eng. Rum disclosed that feasibility studies are currently being conducted on the implementing a national plan for simulated microgravity experiments using carrier probes launched from the Kiruna (Sweden) or Andoja (Norway) sites as well as for parabolic flights carried out with special French or American aircraft.

## Italian Aerospace Projects Presented

### Interplanetary Probe

91MI0286A Rome *AIR PRESS* in Italian  
20 Mar 91 p 657

[Text] The ESA (European Space Agency) has chosen Italspazio to develop the "Sample Acquisition System" for the interplanetary probe Rosetta. This joint ESA and NASA mission involves sending a probe to land on a comet, collect samples of the soil, and bring them back to earth. The system will be required to operate under extreme temperature conditions and will have a high degree of autonomy. The surface of the comet may in fact be quite variable and its consistency similar to that of snow, ice, or even rock. The Sample Acquisition System also includes a robot that can recognize the surface characteristics and then adopt the most appropriate collection techniques. TecnoSpazio, the consortium established by Comau (Fiat Group) and Fair (Finmeccanica Group) for space robotics and automation, is the prime contractor of a team that includes Italian partners and European research institutes such as Tecnomare, Rodio, and Rogalands Forskning.

## Computer Systems

91MI0286B Rome *SPAZIO INFORMAZIONI*  
in Italian 3 Apr 91 p 5

[Text] Over the next five years, Agusta plans to invest approximately 100 billion lire in R&D activities in the space sector. In fact, the "Space Systems Business Unit" is already fully operational at the Agusta Sistemi plant in Tradate (Varese). This unit has approximately 50 employees and was recently assigned contracts from the ASI (Italian Space Agency) and ESA (European Space Agency). In particular, the (EFIM [Manufacturing Industry Holding and Financial Company]) group company is developing computer systems for use in ASI space programs, and has signed a contract for program maintenance and reliability operations with the ESA. Agusta is becoming involved in other sectors such as solar array, satellite positioning and attitude control systems, launchers, and orbit transfer vehicles, and gallium arsenide technology for solar cell manufacture.

## Italy: New Telecommunications Satellite Project Described

91MI0231 Milan *SISTEMI DI TELECOMUNICAZIONI* in Italian Feb 91 pp 40-52

[Article by G. Manoni and F. Mini of Selenia Spazio: "Sarit, the Italian Satellite: Current Status and Guiding Principles of the Project"]

[Excerpts]

### 1. Introduction

The wholly satisfactory results of the recent HDTV (high-definition television) experiment conducted via satellite by the RAI [Italian Broadcasting Corporation] during the Italy '90 world soccer championships have perhaps contributed in some measure to a better understanding of the need for a national DBS [direct satellite broadcasting] service of high quality television programs.

For the first time, a select audience in Italy was able to view an event filmed live in high definition projected on the big screen.

The event was made possible by using the Italian channel permanently available to RAI on Olympus, the large telecommunications satellite placed in orbit by the ESA (European Space Agency) in 1989.

Nevertheless, given the experimental nature of this satellite, the availability of only one channel, and its relatively short operating life, RAI, supported by national industry, has proposed developing an entirely Italian satellite system. This system could make the DSB service operational for the general public, and introduce the broadcasting of high-definition programs even for domestic use.

Market research in this sector shows that the situation in our country is totally different from the rest of Europe, where the presence of a limited number of "private" channels has generated a demand for quantity rather than for quality.

In Italy, where for some time a very large number of programs have been received via the conventional earth networks, it is deemed commercially essential to add a few more channels that offer greater visual and contextual quality.

This foreseeable revolution in television viewing is compared by many to the fairly recent revolution of the introduction of color and, like it, is bound to have a strong impact on advanced industrial sectors (electronic processing, flat screens, etc.), and an increased usage.

The future Italian satellite system, the successor to Olympus, is called Sarit and was recently the subject of a definition study carried out by Selenia Spazio, a company of the IRI-Finmeccanica [Institute for the Reconstruction of Industry - Mechanical Engineering Finance Corporation] group, on behalf of RAI.

The goal of the study was to consolidate the requirements and configuration of the system on the basis of mission specifications agreed upon with RAI.

Figure 1.1 illustrates the work carried out. [Figure not reproduced].

This article describes the results of that work, detailing the guiding principles of the project and the technical solutions adopted.

## 2. The Sarit Mission

The Sarit satellite basically combines two requirements: First, the need to broadcast television programs (conventional and high definition) over the entire national territory; second, the need to put an adequate number of telecommunications channels at the disposal of the manager of broadcasting services to "support" the production of the programs themselves. The transmitting capacity of these channels must be according to the quality of the transmission.

This is a new concept that is reinforced even more by the need to produce HDTV programs that, beyond quality, require a greater degree of in-studio post-production processing, starting from the external filming frequently done in distant locations.

The DBS satellites currently in orbit do not provide for this requirement, the disadvantage being that they must allocate the above-mentioned support services to other satellites.

Of the five DBS channels assigned to Italy by international regulations, two will be dedicated to broadcasting HDTV programs while the remainder will operate with the PAL or MAC standard.

RAI has provided for the use of about five to six digital channels with a 140 Mbit/sec capacity for such a DBS configuration. As will be demonstrated, Sarit can reach its full operating capacity with two satellites, each carrying a mixed broadcasting and support load installed in a medium-sized body.

There are numerous operational, technical, and economic advantages.

First, the principle of staggered launches minimizes the risk of jeopardizing the whole mission should the launcher fail or an essential component malfunction in orbit.

Next, dividing the overall capacity between two "medium" satellites favors the dilution effect of investments as a function of the real demand for orbiting services avoiding more costly launch operations.

The principle requirements underlying the development of the Sarit system are the following:

- direct television broadcasting according to international norms;
- bands and power for HDTV;
- multipoint distribution (120 and 60 Mhz channels);
- 10 year-plus lifetime.

Sarit, in addition, will be capable of using part of its transmitting capability for the implementation of broadcasting services for the general public. Audio-stereo channels, multilingual programs, data transmission and targeted television programs, besides television programs, will all be possible, simply by using a domestic receiver.

## 3. Description of the Satellite

The Sarit system provides for:

- a) a pair (cluster) of two identical satellites placed in geostationary orbit at 19° west, both of which are operational, plus a reserve satellite on earth to be launched in the event of major breakdown of one of the two satellites in orbit;
- b) a network of transceiver stations on earth.

Each operational satellite carries about half of the total capacity required.

This "modular" approach was chosen because of the significant advantages it offers. In fact:

- Since the two satellites in the cluster are identical, the risks and costs of the project as well as its development and back up are minimized;
- the reliability of the system is increased given that each satellite can operate as a mirror image of the other intrinsically protecting the system from major breakdowns;

- a gradual increase in capacity while in orbit is possible and permitting the two satellites to be launched at different times. This permits investments to be calibrated with the real capacity demanded without having to initially configure the system with a capacity equal to that foreseen at the end of its life (10 years);
- it allows a significant saving in launch costs, since a "dedicated" Ariane launch is not necessary, but rather two launches in the so-called "middle Ariane-4" class, each of which costs less than half of the "dedicated" launch.

The salient characteristics of the Sarit satellite are shown in figure 3.1.

**Figure 3.1 - Diagram and general characteristics of the Sarit satellite**

Orbiting life	> 10 years
"Dry" mass of the satellite	740 kg
Bi-propellant mass	1100 kg
Payload mass	350 kg
Maximum launch mass	2200 kg
DC power available, outside of eclipses, at end of life	3000 W
Power absorbed by payload	2400 W
Power absorbed by platform	600 W
Power supplied by the battery in eclipses	1300 W

Each satellite carries a payload consisting of two functionally independent sections:

- 1) a section for direct broadcasting of television programs via satellite within the country, operating in the 18-12 GHz frequency band;
- 2) a section for DBS support services (SS) to transport

and distribute the TV signal, operating in the 13-11 GHz band.

Table 3.2 compares the capabilities and characteristics of Sarit with other existing satellites and those under study in Europe.

**Table 3.2 - Comparison of ratings between the Sarit satellite and other satellites**

Satellite	Life (years)	Weight (kg)	Power (Watt)	EIRP (dBW)	N/CH (D/T)
Eutelsat I (F2/F5)	7	1172	928	45	14T
Eutelsat II	7	1850	3000	52	16 T
TV-Sat	9	2000	3000	63	4 D
TDF-1 (2)	9	2000	3000	63	4 D
Astra	10			52	16 T
BSB 1/2	10	1850	915	59	3 D
TELE-X	7	2000	2300	60	3D+2T
Olympus	5	2532	3600	62.7	2D
Sarit	10	2200	3000	64	3D+5T

(\*) Source: Space Communication and broadcasting, North-Holland Amsterdam, Vol. 6, Number 1-2, May, 88

Notes: D= Direct Broadcasting  
T= Program transport

[passage omitted]

## 6. Development Program

The multipurpose architecture of the Sarit system represents an operationally attractive solution both for national usage, as described in detail, as well as for future diverse or "enlarged" user pools beyond Italy such as developing areas, for example.

A careful marketing strategy could create new opportunities for installation in countries able to have access to at least a part of the technology proposed with Sarit.

The national program provides for the launch of the first satellite in 1994 followed after two to three years by the second. In the event of failure, a reserve satellite will be ready for launching shortly thereafter, compatible with the successive launch windows.

The 1994 date is a target imposed by the need to retain the technical advantage obtained with Olympus up to the end of its operative life.

Thus, the promotional activities carried out by several IRI group companies, RAI, and Selenia Spazio primarily

to proceed with the development of the first satellite during the early months of 1991, appear justified.

The schedule of the entire program is shown in Fig. 6-1.

Selenia Spazio will be the chief contractor thanks to the experience acquired by the company as a systems manager in space developments. For this project in particular the contribution of the knowledge it has acquired will permit Selenia Spazio to play a fundamental role even as the manager of the final integration and launch campaign.

### 6.1 Industrial Organization

The prime contractor's task will be to organize, plan, direct, and control a group of technical and economic activities to ensure compliance with the program's time limits and projected costs.

The development of this management plan will be a time-consuming process in view of the complexity of the program and the potential number of participants.

In addition, the industrial organization will come to depend on how the client chooses to organize himself.

From the general point of view, and thanks to prior experience, the Sarit program will avail itself of consolidated management techniques and resource management centralized in a program office, as is normally the case for projects of a certain size. It will be a kind of "company within a company" able to efficiently direct a series of projects that will involve many Italian and foreign companies.

This office will act as the sole interface with the client, assuring a correct flow of information to and from the internal entities.

The requirements of the program toward subcontractors and partners will be clearly identified in appropriate contractual documents associated with the WBS (Work Breakdown Structure) of the system.

The WBS is a basic document containing all the "work packages" necessary for the development of the project.

Figure 6.1.1 [not reproduced] shows the organization of the program based on recent coordination experiences used for Italsat and Olympus. Possible variations to the structure are being evaluated in relation to the new role of the company.

The organization is based on a mixed structure-program concept. The program manager coordinates the program office for all those activities relating to the management of the program. In addition, project managers delegated by the industrial structure oversee specific areas of the project.

The areas of responsibility will be formally assigned to avoid conflict and make better use of the professional expertise of individuals.

Lastly, management and control methods already successfully tested in prior programs will be adopted:

- a) CADM (Configuration and Data Management) which was already implemented in the configuration of the software to adapt it to the enormous quantity of both technical and management data to be processed;
- b) the "configuration control" committees in various areas which will be formally institutionalized to manage all modifications and variations requested whether internal or emanating from subcontractors;
- c) the activity of the product assurance managers in direct contact with the program office to reach operative decisions within the time limits dictated by the schedule;
- d) the cost control and planning activities which will also be placed in the program office and will use management software capable of measuring work efficiency in real time and supplying data for eventual corrective measures.

### 6.2 Workshare

Selenia's possible program partners are being identified. The guiding principle is the optimization of "make or buy" choices favoring industrial agreements and eliminating redundancies in terms of development costs.

The partners will have to offer strong guarantees in terms of "risk management" in the respective supply contracts.

The innovative developments, as already noted, will be concentrated in the television payload components.

Table 6.2.1 lists some on-board equipment for which a purchase plan is being developed.

[Box insert, p 52]

Important system parameters will influence the choice of the body: operative life, installed on-board power, launch mission. In relation to the mix, interesting options may open up for Sarit in terms of optimizing outfitting times of the Flight Unit (F1) and reducing the project risks.

**Table 6.2.1 - On-Board Machinery To Be Acquired**

- Area: Television payload
- medium and high-power TWTA
- EPC
- High-power switches
- Output multiplier
- Front-end low noise figure
- Channel filters
- Linearizators [linearizzatori]
- IFA
- Area: Body
- Attitude control system
- Primary structure (Italsat derivation)
- Thermal control
- Propulsion system (additional fuel tanks)
- Generator and primary regulator

- Antennae
- DBS and SS feed
- Tracking system

Analyses of possible launchers for Sarit will be extended to the new American and Soviet versions recently placed on the market. [end box insert]

### 6.3 Conclusions

The envisioned development plan of the Sarit satellite, considered to be the natural evolution of the potential shown by Olympus, thus appears to have a strong technological content for Italian industry and Selenia Spazio in particular in the medium term (the next two to three years).

From the economic point of view we maintain that the services offered and the commercial attractiveness of Sarit guarantee the manager more rapid returns than competing systems.

### Italy: Ansaldo, Eltag Report New Projects

91MI0278 Rome *FINMECCANICA NOTIZIE*  
in Italian 28 Feb 91 p 11

[Text] At a meeting in Genoa on 6 February with ASI (Italian Space Agency) president Luciano Guerriero, Ansaldo and Eltag presented a series of projects in the areas of remote-control mobile robotics, artificial intelligence, telesurveying, and propulsion with applications in the space sector.

Ansaldo has developed: the SMT 1 mobile robot, equipped with hybrid locomotion (legs plus wheels) and the MSA [Master Slave Arm] 1 and eventually, a camera to be used as a rover for the exploration of the Moon and Mars; the Master Slave 1 arm, for the Columbus program as an operational support for the European space station in docking missions and the capture of objects in space; and the Mascot system, a pair of remote-control robotized arms.

Ansaldo's other areas of activity in this sector are: the thermodynamic generation of energy: an electric propulsion engine using plasma called "magnetic arc jet engine"; the Astromag project for the development of a magnetic spectrometer with a particle detector that uses a superconducting magnet.

The Emma 2 supercomputer developed by Eltag has artificial vision as one of its most important applications; a first stereoscopic demonstrator for three-dimensional vision already exists, while a system with a moving "eye" will soon be available. Emma 2 can process data and reconstruct images of the earth's surface (with practical applications in the agricultural, hydrogeological, and oceanographic sectors). Filming with satellites equipped with synthetic aperture radars that can "punch holes" in the clouds is also possible.

### Fokker Develops Ariane Booster Recovery System

91AN0316 Rijswijk *POLYTECHNISCH WEEKBLAD*  
in Dutch 14 Feb 91 p 9

[Article by Gerard van Nifterik: "'Recovery' Project Seeks To Extend Braking Distance"]

[Text] Celebrations began last Christmas and the final signatures will probably be added within the next few weeks. With the official signing of the memorandum of understanding Fokker Space & Systems (FSS) will procure a major ESA [European Space Agency] assignment. It concerns the development of a recovery system that enables jettisoned rocket boosters of the new Ariane 5 rocket to return undamaged to the ocean surface.

The development of the Ariane 5, the largest and most advanced rocket in the European Ariane series, will represent a milestone in Europe's aerospace history. Being the future launcher of the Hermes space shuttle, Ariane 5 will enable Europe to make its first manned mission. This means that our continent will no longer depend on U.S. space shuttle flights and that European aerospace will be able to stand on its own two feet.

There is still a long way to go. Ariane 5 as well as Hermes are basically still on the drawing board. Hermes will become operational at the end of the century; the first launch of Ariane 5 is scheduled for 1995. In other words, ESA has fewer than five years left to perfect the technological concept that is to make Ariane 5 the solid backbone of European space flight.

### Evaluation Program

With Ariane's manned missions in mind, ESA has carefully looked into the reliability aspect of the concept. It seems that a lot has been learned from the Challenger disaster, which represented a enormous setback for the U.S. space program five years ago. The problems of the unfortunate space shuttle were caused by flawed connecting seams in one of the booster rockets; for this reason, ESA is paying extra attention to the reliability of this part of the Ariane boosters. In this regard, ESA has developed an evaluation program whereby booster rockets are subjected to detailed examination after use. For this examination to yield useful conclusions, it is necessary that the booster remain intact during and after its return to the earth's surface. Fokker Space & Systems has been contracted for the development of a system guaranteeing the safe and undamaged return of boosters. This project, known as "Recovery," has been contracted to Fokker by Aerospatiale, a prime contractor of the French National Center for Space Studies (CNES), which in turn has been entrusted by ESA with the overall Ariane program management. The Recovery project is not the only one of its kind; however, it is unique as regards its scope and requirements.

### Altitude and Speed

Ariane 5 will have two booster rockets, each filled with approximately 200 tons of solid propellant. A few minutes after launch, these more than 30-meter-long boosters are jettisoned and fall back to earth following a more or less parabolic trajectory during which their speed is reduced by atmospheric drag (from maximum 2,500 meters per second to approximately 300 meters per second). Fokker's recovery system will enter into operation when the speed of the auxiliary rockets has decreased to subsonic levels (approximately 300 meters per second). The purpose of the system is to further reduce booster speed to a mere 25 meters per second before splashdown using a series of parachutes.

As simple as it may seem, this assignment is not at all easy. According to Eng R. Bloem and Eng P.P.J. Boersma, project manager and contract officer in the Recovery project respectively, several factors, such as the combination of speed and altitude at which the parachutes start to function, play a critical role. On the one hand, speed must not be too high when the first parachute opens, i.e., no more than 300 meters per second, or otherwise the parachute tears to pieces. On the other hand, deployment of the first parachute cannot be postponed too long because the system requires a certain braking distance in order to make a soft landing. So FSS is facing a real dilemma: The braking system should preferably be activated at the highest possible altitude but this is impossible because booster speed is too high; if, however, the parachutes are deployed too late, the brake path is too short and the maximum landing speed of 25 meters per second is exceeded.

According to Boersma, the optimum would be somewhere between 7 and 5 kilometers altitude, when the booster is traveling at speeds of between 280 and 300 meters per second; the margin, however, is very small. Further research will reveal whether the parachutes can be opened successfully at higher speeds.

### Parachutes

The braking process as envisaged by FSS is as follows: At an altitude of between 5 and 7 km, the booster's nose cone is jettisoned by, for example, two small auxiliary thrusters. This automatically activates the so-called auxiliary chute, which, in turn, pulls out a second parachute: the drogue chute. The latter is attached to a specially designed anchor which is fitted with two cutting devices containing small explosive charges to detonate and then deploy the drogue chute's pack. This procedure takes place at an altitude of approximately 2 kilometers and has two consequences: The drogue chute extracts the three main parachutes and is cast off, after which the main parachutes are deployed. This is not done at one fell swoop but in phases, whereby the diameter of the parachutes is gradually increased by cutting the reefing lines, thus increasing braking power. After two unreefing phases, the main parachute reaches its highest braking capacity with a diameter of 14 meters. Bloem says that

the phased approach is necessary because otherwise the opening shock applied to the nylon fabric of the chute would be too great, increasing the chances of the chute being torn to shreds.

### Electronics

All the parachutes and related cords together weigh 1,300 kilograms; they are ingeniously folded—under pressure—in a special canister, which is simply a barrel-shaped dispenser made of a glass-fiber reinforced plastic. It weighs nearly 120 kilograms and houses the parachutes as well as the cables, the thickest of which consist of 6-centimeter-thick kevlar ropes.

Electronics play an important role in the recovery system. It ensures that the system does not enter into operation as long as the booster is attached to the Ariane rocket but only when it starts returning to earth.

Electronics is also essential for the sensors that precisely determine the altitude. Their data are used for electronic control and positioning of the auxiliary chute and also for activating the various cutting devices, for example. Given the short time frames for all these operations (the total operation from auxiliary chute deployment to splashdown takes only 90 seconds), altitude measurements have to be extremely accurate. However, measurements made by the pressure sensors are influenced by the way the booster is falling. Possible deviations are corrected by electronics. Uncertainty concerning the fall direction is yet another complication. The booster's center of gravity is somewhere in the middle and it is possible that the huge rocket will start to sway and roll.

### Subcontractor

The development of the sensors and the electrical system is not the direct responsibility of Fokker. FSS has been commissioned by Aerospatiale to handle overall system design and project management. FSS is subcontracting components production to third parties at home and abroad. Twenty-two percent of the overall contract was given to Germany, 45 percent to Spanish industry, and 33 percent remained in the Netherlands; this allocation occurred along the lines of the geographical distribution code that ESA tends to apply. This principle is that the total value of subcontracts allocated to a particular country corresponds to the percentage of its contribution to ESA's budget.

The electronics systems are developed by one of FSS' subcontractors: the Spanish company Sener. The production of the parachute has been assigned to the Spanish company Cimsa, while the parachute is being designed by the German company AFG Autoflug. Stork Product Engineering Amsterdam is responsible for designing the canister and the anchor; Polymarin (at Medemblik, Netherlands) is in charge of final design and production of the canister.

A sixth participant—the Dutch National Aviation and Space Laboratory (NLR)—has thus far been playing an

important role. For quite some time now, Fokker has cooperated with the NLR to perform subsonic, transonic, and supersonic wind tunnel experiments on the basis of which the initial rough dimensions and the reentry simulation were defined; these tests have also been instrumental in the realization of contracts. These experiments, which also investigate the possible earlier deployment of the parachutes, will continue until the summer.

In the meantime, Fokker has reached an agreement with all participants in the project, which has been allocated 40 million guilders by ESA for a period of five years.

#### **Fine-Tuning the System**

Experiments, such as those performed by the NLR, show that the configuration of the recovery system is not definitive yet. The principles and rough outline of the project are known, but further development will require many changes. For example, if the parachutes can be deployed earlier than has been assumed so far, the braking distance would be longer and a smaller parachute would suffice. Consequently, a lighter system could be constructed. This, in turn, would affect the location of the center of gravity and the stability of the booster (a lighter recovery system increases booster stability), which would again have an impact on the correcting capabilities of the electronics.

Fokker Space & Systems is confident that most technical details will be worked out within the next 6 months. It plans to deliver the first flight models in the spring of 1994 and to begin full-scale production of the recovery system immediately afterwards. Production management will also be handled by Fokker.

[Caption to figure not reproduced]: 1. After the Ariane rocket has jettisoned its boosters, the electronics systems control the automatic ejection of the booster nose cones. This takes place at 5 to 7 kilometers altitude. 2. The ejection of the nose cone releases the auxiliary chute, that in turn pulls out the drogue chute. 3. The drogue chute is pulled out by the auxiliary chute. The drogue chute is attached to a specially designed anchor which incorporates two cutting devices that can cut the drogue chute's pack free. 4. The drogue chute's pack is cut free at an altitude of 2,000 meters, pulling out the three main parachutes. The drogue chute is jettisoned and the phased deployment of the three main parachutes begins.

### **AUTOMOTIVE INDUSTRY**

#### **Peugeot Starts Up Parts Recycling Plant**

91AN0397 *Toddington NEW MATERIALS INTERNATIONAL in English Apr 91 p 1*

[Text] The dismantling of wrecked cars so that the materials used inside can be recycled is being studied by Citroen and Renault. Renault's experimental plant at Flins is already operational while Peugeot SA's (PSA) at Saint-Pierre-de-Chandieu, will start running in June.

In France, only a quarter of the material in a car is currently recycled leaving 350,000 tonnes (mostly plastic, rubber and glass) to be dumped every year.

PSA's new 20 million French francs [Fr] recycling plant is expected to "process" 7,200 wrecks during its first two years of operation. But plastics will be sorted out for recycling only where it can be done profitably.

To ease the recycling process, PSA makes 90 percent of the plastic components on its cars from seven polymers. However, not all the plastics used are recyclable and in the new PSA facility, the parts will be sorted and those which are combustible will be burnt in an incinerator.

To assist the recycling function, PSA and Renault have agreed a system of marking the polymers which will be used on all their new models. Rover Group in the UK started a similar system at the start of the year.

Meanwhile, Renault has just given approval for a polypropylene recycled from battery cases to be used for a component for the Clio. The project was carried out in partnership with recycling specialist C2P and chemical company Atochem.

#### **French Clean Transportation Projects Noted**

91AN0314 *Paris RECHERCHE TECHNOLOGIE in French Feb 91 pp 11-13*

[Unattributed article: "Initial Evaluation of PREDIT"]

[Text] Eight months after the launch by Michel Delebarre [minister of state for urban affairs], Roger Fauroux [minister of industry and land management], and Hubert Curien [minister of research and technology] of the R&D program for Innovation and Technology in Ground Transport (PREDIT)—one of whose major guidelines is consideration of environmental imperatives—the initial evaluation confirms the strong mobilization of the sectors involved as well as the professional interest in research and development in the field.

PREDIT's first term was marked by a certain number of events: first, the establishment of a supervisory body including 21 scientific and technical committees and study groups on environmental, energy, and security matters; second, the launch of well-defined major technological programs, such as those on the Clean Economical Car (VPE) and the Future High-Speed Train (TGV), or programs still under development on road safety and multimode transportation. In addition, the transition of the countries of Central and Eastern Europe to a market economy should have a significant influence on European transport, especially ground transport.

#### **Resources Employed**

PREDIT's start-up protocol projected a program budget of 8.3 billion French francs [Fr] for the 1990-1994 period, i.e., an annual average of Fr1.66 billion. R&D expenditure for 1990 amounted to Fr1.5 billion, including approximately Fr490 million in state funding.

Compared to 1989—a year of program preparation—this represents a very significant increase in expenditure, on the order of 66 percent as regards state funding.

This major increase—which is obviously a source of satisfaction for trade—is attributable primarily to three factors: The fact that research in ground transport in 1987-1989 suffered a substantial setback from the budget economies of 1986; the increasing importance of EUREKA [European Research Coordination Agency] projects; and the launch of major programs, the last two (VPE and the future TGV) having secured substantial credits.

According to the experts, this trend should grow in 1991 since these major programs will together tie up 40 percent of government funding.

#### Partnership

PREDIT's ambition is to strengthen the ground transport sector's coordination tools in the area of scientific, technical, and socio-economic research and to increase the coherence and efficiency of projects undertaken by the various partners. In this regard, the contribution of the major research bodies is especially important: The expansion of their activity to the transport sector will in effect make it possible to strengthen the link between basic research and technological developments, as well as to explore new ways for generating substantial profits in the future. We may cite, for example, current work in the VPE project on electric vehicles which, for certain key projects, could pool the resources of industry and of national and European research centers. Beyond that, in order to improve urban traffic and transport conditions, PREDIT partners have agreed to reinforce research efforts in the socio-economic field.

All these projects are indicative of the government's determination to invest heavily in medium-term research through key programs. In addition, European integration is one of the major guidelines for PREDIT, the same as it is for the EUREKA programs, which by their quality constitute a major stimulus for such cooperation. In this regard need be mentioned the Prometheus and Carminat programs. The latter is now completed and the remarkable results achieved and exhibited at the latest Automobile Show demonstrate once again—if that were necessary—the worldwide interest in this effort.

[Box, p 12]

#### Multimode Transportation

Multimode transportation consists of the successive use, for a single shipment, of various modes: sea, road, rail, river.

A research program is currently under development by the PREDIT "Goods Transport" Expert Committee, bringing together carriers (road, rail, port, air), operators, representatives of industry, and specialists from

research organizations. Its purpose is to make the system more efficient by achieving a degree of industrialization that will make it possible to save time, transport capacity, and organization.

These programs will cover:

—High-performance transshipment and handling systems;—Logistics and services;—Materials and equipment.

All research projects will represent approximately Fr500-550 million for the next four years.

[Box, p 12]

#### The Future TGV Program

Since its entry into service in 1981, the southeast TGV has proved itself an economic and commercial success and has dramatically highlighted the basic qualities of rail transport: safety, protection of the environment, and energy conservation.

To respond to these requirements, GEC-Alsthom proposed to the National Railway Company (SNCF) and to the public authorities an ambitious four-year R&D program covering TGV rolling stock. The aim of this Fr445-million program including Fr150 million in government funding—is the design of a new generation of trains that can operate at speeds of 350 km/h on international runs. In addition, shock waves produced by the entry of the TGV into tunnels will be studied using a model, the equipment of which can be made on the strength of support by the Ministry of Research and Technology (MRT) and the SNCF; the equipment will be designed and built by the Sardou company.

#### Technological Breakthrough: TGV-2N

The future TGV program was preceded by a technological breakthrough in the form of the "two-level TGV" (TGV-2N) launched in 1989. Its aim was to increase by 40 percent passenger capacity of the current TGV. Research was thus undertaken on the use of lighter materials and their crash resistance at high-speeds (a study which so far has not been completed) in order to maintain the same stress on the railbed as a one-level TGV.

This program, funded for Fr32 million over three years (MRT's share being Fr12 million), is under the leadership of Alsthom and the SNCF. To date, the program has resulted in the construction of the first prototype body (a second prototype is in the pipeline), which will undergo compression trials at the SNCF test site in Vitry-sur-Seine.

[Box, p 13]

#### The Clean Economical Vehicle Program

The emission into the atmosphere of road vehicle combustion gases constitutes one of the major causes of

atmospheric pollution, especially in urban areas. It is the reason for which the public authorities and the two national automobile manufacturers have agreed to join forces in an ambitious research program to develop an environmentally clean and economical vehicle.

This Fr1.2-billion program, which will cover a period of eight years, will explore all possible means eventually leading to significant reductions in atmospheric pollutant and CO<sub>2</sub> automobile emissions. A protocol for this purpose was signed with Renault and Peugeot on 23 January 1990; its purpose was to bring together industry and laboratory resources to deal with the overall problem through a comprehensive approach covering the fuel system, engine, and antipollution processes.

Some of the program's are:

- To examine alternative solutions to make it possible, over the medium term, to enter a new stage of pollutant emission reduction. These are in particular: the design of a new two-stroke engine and the study of devices allowing the large-scale use of substitute fuels that produce less CO<sub>2</sub>, as well as possible new developments in petrol-based fuels;

- To undertake the development of electric vehicles for urban and road traffic (the latter with turbogenerators) and of engines running on hydrogen or fuel cells.

We should mention that the EC has just given its approval for the entire "Clean Economical Vehicle" program, which can now enter its operational phase.

### Citroen Combines CAD, Three-Dimensional Measurement

91WS0228A Paris L'USINE NOUVELLE  
in French 21 Feb 91 pp 60-61

[Article by Stephane Farhi: "First at Citroen in its Charleville-Mezieres Foundry - 3D Measurement Plugs in to CAD"]

[Text] The combination of 3D measurement machines and CAD systems is spreading, from the direct acquisition of control sequences to interactive data exchange between the measurement system and design.

3D mechanical measurement is becoming an integral part of CADAM [computer-assisted design and manufacturing]. The development of software links between CAD [computer-assisted design] systems and three-dimensional measurement devices (TDMD) now makes it possible to retrieve control sequences for parts from CAD-originated files. In parallel with this "downward" feed, there is another, "upward" feed taking place. The purpose of uploading the measurements made by the measuring device to the CAD is to achieve interactivity between measurement system and design system. Citroen has just added a facility using this approach (produced by DEA of Italy) at its Charleville-Mezieres foundry —no doubt a first in France...

The decisive step: the generation of control sequences. CADAM is used to create machining sequences and tool itineraries, while CATDM (computer-assisted three-dimensional measurement) does the same for control sequences. The process is exactly the same.

Based on the mathematical description of a part, a "measurement" module in the CAD software selects the control points, references, and tolerances. In this way, the path of the sensor can be displayed on the screen, creating a simulated measurement. A post-processor then translates the resulting data in order to send them to the TDMD's digital control; the translation must be understandable by the measurement machine.

There are two ways of doing this. The first is for the major CAD software publishers (Computervision, Dassault Systemes, Matra Datavision, McDonnell Douglas) and the TDMD manufacturers (DEA, Zeiss, Mitutoyo, Renault Automation, etc.) to use a standard interface called DMIS (dimensional measuring interface specification). Previously, software publishers and MMT [manufacturing methods and technology] manufacturers had to develop specific interfaces for each CAD software system (DEA developed Meacad for Catia and Cadam, while Computervision used a neutral file). With DMIS, the CAD data are sent to a special file that a post-processor translates into the TDMD software language, which pilots the digital control.

The other solution, developed by the U.S. firm Valisys and acquired by IBM in 1989, consists of sending the data directly from the CAD software (in this case, Catia) to the digital control system of the measuring device. Disadvantages: All the piloting is done from the CAD (which is clumsy) and the TDMD's own software is bypassed. So, in order to remedy this, Valisys has also decided to use DMIS...

Programming the measuring device from the CAD does not eliminate the previous methods. Self-teaching is the most wide-spread. The problem is that while the TDMD is being used to prepare the sequences, it's not measuring!

Off-line programming is another technique, which consists of preparing control sequences in concealed-time while the TDMD is working. "The best way is to have all three programming methods, because a potential for local programming must be maintained," believes Serge Durand of DEA France.

CATDM is in full bloom in the automobile industry, where it is used to control molds and castings, and also for machine parts or forgings. PSA uses it at Mulhouse, Renault at Billancourt, and RVI at Venissieux.

This first-time CAD-3D measurement link is joined by a second which gives this technology its real interactivity. Using special software (Surfer from DEA, Perceval from Renault Automation) the measurements made on the parts are uploaded to the CAD. Surfer, for example, "mathematizes" the parts' surfaces in order to enter

them in the CAD system. Using a few points read by the TDMD, the software reconstitutes a surface that can immediately be checked on the screen and corrected. This system is ten times faster than digitizing, which requires hundreds of point readings. This method permits the creation of control "micro-programs" covering certain portions of a part, making it possible to define quality control strategies (for supplier assurance, for example).

It is also possible to compare a CAD part design with a prototype or pre-production-line model. This is what Citroen is doing in its Charleville-Mezieres unit. This aluminum and iron parts foundry, which specifically manufactures all the safety parts (control arms, steering arms) for the PSA group, is equipped with a complete 3D measurement system. It took two years to set up the equipment, which is valued at more than 10 million francs. The unit includes an IBM-Catia CAD station, a measurement bridge connected to a Micro-Vax, and three production-line measuring robots linked by an Ethernet network. It plays two roles: the design of control programs for the robots and the measuring device and the control of the mold models and prototype parts. The objective is to correct the model in CAD in order to obtain the proper mold. Other applications of this system are being studied at PSA.

## BIOTECHNOLOGY

### EEC: Bioethics Coordination Center Proposed

91WS0236A Paris *BIO LA LETTRE DES BIOTECHNOLOGIES* in French 30 Jan 91 p 1

[Unattributed article: "EEC: Toward the Creation of a Bioethics Observatory?"]

[Text] Alain Pompidou, in behalf of the Commission on Energy, Research, and Engineering, announced the extension of the specific 87-91 Biomedicine and Health research program (90-94), which has an endowment of 133 million European currency units [ECU], with 45 million reserved for the analysis of the human genome and 88 million for biomedicine and health. The commission's report calls for a greater effort in the fight against AIDS (55 to 90 percent instead of 45 to 50 percent of expenditures), amounting to ECU48 to 53 million. The work on AIDS includes the development of a European EVA vaccine and the testing of antivirus drugs (ADAM).

The reporter proposes that 5 percent of the medical research budget, or ECU6 million, be devoted to bioethics research. This would be the first time funds are set aside for bioethics. This will allow not only some objective research, but also cooperation and exchanges between multidisciplinary researchers in the various centers at specific sites, exchanges between jurists, sociologists, economists, scientists, physicians, and biologists.

The reporter further proposes the establishment of an "observatory without walls" for European bioethics.

This center would be devoted to paving the way for cooperative efforts among experts, biologists, physicians, philosophers, religious leaders, sociologists, economists, and would be aimed at locating and allocating the necessary funds. The center could function as follows: The various national ethics committees would cooperate and work on precise topics, including medically-assisted procreation and organ transplants, and research would be financed by the European program.

### French Parliament Proposes UN Ecosystem Watchdog

91WS0311A Paris *LE MONDE* in French  
18 Apr 91 p 14

[Article by Catherine Vincent: "Parliamentary Report Proposes Creation of International Biosystem Observatory"]

[Text] A report by the Parliamentary Office for the Evaluation of Scientific and Technical Decisions takes stock of the applications of biotechnology to agriculture and the food-farming industry and proposes the creation of an international biosystem observatory.

### Biotechnology

Although it can't be seen on our dinner plates, it makes crops grow, improves livestock, and could help solve the problem of hunger in the world. Just 20 years ago, the term itself was unknown: "the use of biological organisms, systems, and processes" for "industrial, manufacturing, and service" purposes. So the topic of the report goes far beyond the use of genetically modified organisms, which in France is controlled by the biomolecular engineering commission (*Le Monde*, 11 April). In order to produce this document, Mr. Daniel Chevallier, deputy from the Hautes-Alpes and a trained researcher, sought the opinions of several dozen French and foreign scientific and industrial leaders. The resulting 25 recommendations cover research, education, public information, patentability, and regulations on experimentation.

According to Mr. Chevallier, "These new techniques should not entail deep-seated changes in the farmer's work, but they will call for significant changes in his relations with his suppliers and, further down the line, with the industries to which he supplies raw materials. It is therefore absolutely necessary to involve the farming community in this movement as soon as possible, particularly through its own organizations."

Sooner or later, the food-farming industry (IAA) will also have to adapt to the introduction of these new techniques. The United States and Japan have known this for some time, and are devoting more and more research to biotechnology. In France, the situation is more serious. As the Economic and Social Council pointed out in its report on the status of research in France, "The IAA is the red light among French industries, devoting only

0.78 percent of its added value to research, as compared to 2.8 percent for other industries as a whole."

### Ecological Debate

Overall, the food-farming industry spends some 1.2 billion French francs [Fr] a year for research, about 0.2 percent of sales—less than Nestle, scarcely more than General Foods. In Chevallier's opinion, "This situation makes it extremely necessary to involve the INRA [National Agronomic Research Institute] in basic transferable research."

Another debate revolves around ecological concerns: Is the introduction of genetically modified plants or micro-organisms (OGM) into the natural setting hazardous to the environment? To date, although current experiments are surrounded by all the required precautions, no scientist or manufacturer is capable of answering that question in the negative. As a result, the Parliamentary Evaluation Office emphasizes the need for research organizations "to determine as accurately as possible the potential consequences of unleashing OGMs in the global ecosystem," in order to produce a model "which could be used to analyze and correct accidental occurrences."

The last suggestion of the report involves the creation at the international level of a specialized UN organization, a sort of "international bio-equilibrium observatory." Among other things, it would be responsible for monitoring and controlling the decline of genetic diversity. The uniformization of plant and animal species could actually have serious consequences on ecosystems. The results can already be seen in developing countries, where the supply of high-yield hybrid seeds to farmers has accelerated the disappearance of food crops and local varieties, thereby contributing to the impoverishment of the countryside and encouraging the exodus towards urban areas.

Note: This report was presented at Bioexpo 90, held in Paris April 9-12.

### France: CEA, CNRS Form Biological Research Institute

91WS0216B Paris AFP SCIENCES in French  
21 Feb 91 p 33

[Unattributed article: "Structural Biological Institute Created"]

[Text] Paris—The Atomic Energy Commission [CEA] and the National Center for Scientific Research [CNRS] have signed an agreement creating the Institute of Structural Biology [IBS], in connection with which construction work began last week at Grenoble's Louis Neel complex, according to a joint press release by the two agencies on 20 February.

This European-scale basic research institute was formed so as to bring about a closer interweaving of French

efforts in the field of molecular bioengineering, a pivotal sector of the future, particularly for the chemical, pharmaceutical, and farming and food sectors, in connection with which the CEA launched the Proteine 2.000 program in 1988, and the CNRS its IMABIO program in January 1990.

The agreement to form the IBS was signed a month ago by Messrs Philippe Rouvillois, managing director of the CEA, and Francois Kourilsky, general director of the CNRS. Initially, Mr. Hubert Curien, minister of research and technology, was to have laid the ceremonial first stone, but circumstances prevented this; hence the press release.

The IBS, for which 45 million francs [Fr] have been allocated to construction work, is to be operational, with a staff of up to 200 persons, by the end of this year. Its funding will be shared equally by the CEA and the CNRS.

The Institute will specialize in structural studies on biological macromolecules—such as proteins and nucleic acids—so as to better understand the relation between their spatial structures and their functions. Following the affiliating of the National Institute of Health and Medical Research [INSERM] and the Joseph Fourier University with the CNRS and the CEA, the IBS will federate the available capabilities—of biologists, biochemists, chemists, physicists, computer scientists, etc.—so as to provide the complementarity of multiple disciplines that is indispensable in this cutting-edge field of research.

In the Grenoble environment, the IBS will be able to benefit from its nearness to the CEA's Grenoble Research Center biology laboratories, which, in turn, are associated with the CNRS and INSERM, and from its nearness to the university campus and to high-technology exploration facilities, such as the Institut Laue-Langevin's accelerators and the European synchrotron radiation facility [ESRF], whose high-intensity radiation beam will be available by 1994.

### French Program for Deviant Gene Identification Launched

91WS0236B Paris BIO LA LETTRE DES  
BIOTECHNOLOGIES in French 30 Jan 91 pp 2-3

[Unattributed article: "AFM: Inauguration of the Gene-thon Program"]

[Text] More than 3000 genetic illnesses account for 30 percent of infant mortality cases in the western world, and for 25 percent of handicaps. Although some of these illnesses may be benign, others are incapacitating and sometimes fatal. Some are known, such as non-insulin-dependent diabetes, while others, such as the lysosomal (anomaly of a cellular organoid) or Rett's syndrome (mental problems associated with a physical handicap) are unknown and rare.

Comforted by the explosion of human-applied genetics and by the hopes offered by this scientific discipline, the Association Francaise contre les Myopathies [French Association Against Myopathic Disorders] (AFP) had promised during the 89 Telethon to set up a plan for combatting genetic illnesses, since neuromuscular illnesses are totally or partially dependent on the genetic approach. And it has done so. The Genethon Program was set up in six months, thanks to the funds from Telethon 89. With 3200 square meters of space at the AFM unit in Evry (91), the laboratories represent an investment of 120 MF over three years. Directed by Prof. Daniel Cohen (CEPH) and Prof. Jean Weissenbach (Cnrs [National Center for Scientific Research]), the program was designed for the sole purpose of discovering the origin of genetic illnesses. It uses the reverse genetics technique, which makes it possible to discover genes from the patient's blood instead of from protein, and provides a new outlook for illnesses labeled incurable. Using state-of-the-art techniques in molecular genetics, this vast research program should speed up discoveries considerably. It took six years to identify the gene responsible for Duchenne's syndrome and the one responsible for fibrocystic disease. Now, eight to 10 months should be sufficient. Genethon, a nonprofit service organization created through close collaboration between the AFM and the CEPH, is the only program of its kind in Europe. It is available to the French and international scientific communities.

Genethon has computerized equipment that helps navigate through the various stages leading to the discovery of the gene responsible for a disease. For each disease, the gene bank makes it possible to assemble the genetic background necessary for research and to obtain enough DNA from a blood sample, by culturing cells, to meet the demands of the research teams. These immortalized cells (lymphoblastoid strains) are stored in liquid nitrogen at  $-196^{\circ}\text{C}$  in order to extract the DNA preserved at  $-80^{\circ}\text{C}$ . The storage capacity of the Genethon bank is currently 100,000 samples, and can easily be increased. Therefore, researchers need the active cooperation of patients and family members in order to do their work.

A comparative study of DNA fragments from all the members of a family, whether or not they are ill, makes it possible to locate the genetic anomaly geographically. This, in turn, allows a precise diagnosis and makes it possible to quickly prescribe the appropriate treatment and to provide genetic counseling. 20 robots, designed by Bertin as part of the Eureka project and supervised by Genethon technicians, can perform the localization procedures as efficiently as 100 researchers (6720 blood samples processed in 19 hours). The next step is to detect the genetic abnormality by linking the four bases (ATGC) that comprise the gene. Identification is achieved through a highly complex strategy that is dependent on several factors (numbers of informative probes, yac [sic] banks, associated pathologies in the same patient, etc.). We know that each gene is associated with a specific protein whose dysfunction or absence

causes the disease. A knowledge of the molecular formula helps to determine a rational treatment, which then may involve the fields of pharmacology, cell therapy, or genetic engineering. The set of resources implemented at Genethon (gene bank, DNA extractors and sequencers, Southern Blot machines, polymorphic probes, etc.) will completely change the outlook for this critical stage in disease control. The program will also soon be making contributions to the determination of the order of the genes on the genome, particularly the genes responsible for disease: the genetic map. In a second stage, it will make it possible to determine the exact positioning of the chemical composition of genes: the physical map.

The AFM is an association of patients and their families now numbering 30,000. Its members are working together in the fight against 40 diseases that affect the neuromuscular system and are characterized by the gradual loss of muscle-related functions. More than half these diseases, particularly those affecting children, are associated with a limited life expectancy. They involve some 50,000 French citizens. The various Telethons held since 1987 have made it possible to initiate or develop indispensable research programs (220 subsidies in 1990). The first success was the localization of the Spina Amyotriophia gene (March 1990). The genes responsible for 4 other serious diseases have also been localized: facio-scapulo-humeral myopathia, neo-natal pseudo-adreno-leuco dystrophy, X-related hydrocephalia, and pelvic myopathia.

AFM (Bernard Barataud, President) - 13 Place de Rungis, 75013 Paris. Tel.(1).45.65.13.00.

#### **Germany: Electrical Pulses Aid in Genetic Transfer, Cellular Fusion**

91P60160 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 29 Apr 91 p 10

[Text] Bio-med GmbH in Theres, Schloss Dittfurth, has developed two devices making possible gene transfer by means of electrical pulses. According to statements by business manager Dr. Harde Freiherr von Grise, the devices can be used for cellular fusion and electroinjection. Contemporary genetic engineering deals with the penetration of genetic materials into a cell. For some fields of application, however, entire cells are fused with one another.

This cellular fusion is necessary, for example, for the generation of hybridoma cells serving for the manufacture of monoclonal antibodies. The cultivation of plants also employs cellular fusion. As stated by Grise, electrical cellular fusion was developed as an alternative to conventional fusion techniques. In these [latter] techniques, cells are fused together using chemicals or inert viruses.

Of course, conventional methods are mostly unsatisfactorily with regard to the yield of fused cells. The firm's Biojet cellular fusion (CF) device now makes possible

microprocessor-controlled electrical cellular fusion. The [device] consists of a high voltage pulse generator which produces the DC pulses required for cellular fusion, the switching electronics and a variable field generator.

In order to fuse cells, they are introduced into a fusion chamber in a medium amenable to osmosis. The variable field generator, operating at frequencies between 0.1 and 10 MHz, sets up a variable field in the chamber. The cells gravitate toward the electrodes, forming pairs there or short chains. Once this process is set into motion, fusion itself is introduced by means of a high voltage pulse which generates a rectangular pulse of 5 to 100 microseconds duration.

The maximum voltage is 400 volts (V). The pulses can be released at intervals of from 0.1 second to 999.9 seconds. The strong pulses penetrate the cell membrane and usher in the fusion of adjacent cells. The process is controlled using a microprocessor. It also permits the storage of various fusion programs.

The firm's other [new] device offers the possibility of electroinjection of substances into individual cells. According to Cise, this injection is simple and gentle to the cells [involved]. [The injection] can be employed for transferring molecules of hereditary material (DNS), dyes, proteins, and pharmaceutical substances, as well as for liberating substances from a cell. Here then, an electrical pulse of up to 15,000 volts (V) renders a cell membrane permeable. The cells themselves subsequently repair the membrane.

#### **Germany: Recycling Reduces Costs in Fermentation Operations**

91P60164 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 24 Apr 91 p 8

[Text] By using a continuous culture fermenter in the production of monoclonal antibodies in mammalian cell cultures, nearly 80 percent of the nutritive medium can be recycled. Thus, the overall cost of the medium can be reduced by more than 40 percent, and the amount of waste water can be reduced by 45 percent. At the same time, researchers of the cell culture technology working group of the University of Bielefeld have made use of the observation made by Japanese scientists years ago to the effect that the nutritive medium used for growing cells can be reused for further cell cultivation.

The researchers have now applied the principle in a continuous culture fermenter which operates using a serum-free medium. In that way, the nutritive medium of a perfusion reactor, in which cells placed on hollow fibers are flooded and gassed with nutritive fluid, can be easily withdrawn, partially reconstituted and used again in the same reactor.

The Bielefeld biotechnologists removed 80 percent of the [original] medium, added to it a concentrated solution of glucose and amino acids to bring the volume back up to

100 percent and reused the medium in perfusion operations. The animal cells (rat and mouse hybridoma cells) continued to flourish and produce under these conditions, practically as well as after the addition of fresh medium. As the cells grow, the stock of lowmolecular constituents is the first to be exhausted, while the medium still contains sufficient quantities of higher-molecular protein components. These, above all, have catalytic and growth-stimulating properties and constitute the bulk of the cost of the medium. On the contrary, after the initial growth cycle, inhibitors which become concentrated during the growth of cells in the medium are clearly present in such low concentrations that they are rendered ineffective by the dilution of the recycled medium with medium concentrate.

Since, by the second reuse, the product yield declines, the biotechnologists recommend that the medium be totally replaced with fresh nutritive material, after its first reuse. Insofar as this can be treated as an antigen-antibody reaction (Elisa), the product—monoclonal antibodies—does not appear to be degraded by the growth of the cells in recycled medium.

However, before products for therapeutic purposes are derived using this selfsame principle, it must be ascertained that the product in no wise undergoes qualitative changes under altered growth conditions in a recycled medium.

#### **German Firm Improves Monoclonal Antibodies Production**

91P60165 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 3 May 91 p 8

[Text] Fresenius AG in St. Wendeln has developed an autoclavable hollow fiber bioreactor module for the production of monoclonal antibodies. It operates on the basis of hollow fiber technology. According to Fresenius' director in charge of the project, Reinhard Gergen, the combination of two types of hollow fiber membranes in one reactor module makes possible and improvement in the oxygen supply and a savings in nutritive medium.

Hollow fiber technology involves a separation between producer cells and the nutritive medium. The cells are situated outside the hollow fibers, in an extracapillary region. The nutritive solution can make its way through the permeable polysulphone hollow fiber membrane to the cells, thus enabling their growth. While antibodies produced by the cells become concentrated in the extracapillary region, toxic metabolites migrate through the membrane, thus detoxifying the cell culture medium. In this way, the purification of the monoclonal antibodies is facilitated and the density of the cells produced is increased, thus making for more efficient production overall.

Although hollow fibers are already being used in numerous processes, a few problems have remained unsolved for quite some time. One of those [problems] is

the supply of oxygen to growing cells. As stated by Gergen, in conventional capillary action reactors, this [oxygen] supply is effected via the oxygen-enriched nutritive medium. However, for very high cell densities, this type of oxygen supply constitutes a constraint.

Moreover, the linkup of the nutritive material and oxygen feeds leads to an unnecessary elevation in the flow of nutritive media. In the Fresenius reactor module, this linkup is dispensed with by using two types of hollow fiber membranes. The supplying of the cells with oxygen is effected via a gas dispersion membrane in the reactor chamber itself. In this way, alternative routing past [the stage where] the nutritive medium is exposed to gas, is eliminated. The module comes in two sizes with an extracapillary volume of 385 or 700 milliliters (ml). It consists of an autoclavable polycarbonate chamber with an appropriate hose and hollow fiber system. A porous polyethylene membrane is placed in the reactor as a gas dispersion membrane. This makes it possible to expose the medium to a gas without [forced] venting. Also, for high densities of over ten million [cells] per milliliter, an adequate oxygen supply should be possible.

The reactor module can be used in two operational modes. In the "single pass" mode, the nutritive medium is introduced into the reactor chamber only once; on the other hand, in the "recirculation mode" [the nutritive medium can be reintroduced] many times. Reportedly, in the recirculation mode, [the module has successfully produced] up to two milligrams (mg) of monoclonal antibodies per milliliter, consuming a total of five milliliters of medium per milligram of antibodies.

#### **Germany: Second Generation DNA Sequencer Developed**

91P60179 Frankfurt/Main FRANKFURTER  
ZEITUNG/BLICK DURCH DIE WIRTSCHAFT  
in German 2 May 91 p 8

[Text] By using ultrathin polyacrylamide gels, W. Ansoerge of the European Molecular Biology Laboratory in Heidelberg has succeeded in accelerating, by a full order of magnitude, the rate at which the component sequences of molecules of hereditary material are determined. Using a sequencer of the second generation for deoxyribonucleic acid (DNA), instead of the 40 to 100 components (bases) per day and per clone which for a long time were the standard, 500 to 1000 bases per day and per clone can be sequenced in a chain of molecules. In a 40-cm length of gel, at least 600 bases can be read off on-line and virtually without error.

As in the first generation DNA sequencer, the second generation Heidelberg sequencer also employs fluorescent marking in which, for each of the four different bases, a different fluorescent dye is used. The ultrathin gel [layers] used nowadays, in which the fragments of the molecule of hereditary material to be studied are broken up, offer three advantages. The temperature gradient, measured transversely through the thickness of the gel,

remains so small that thermal effects rarely cause deflections of the molecules traveling through the gel.

The generation of Joule heat is minimal, so that operation at high field strengths is possible, thus leading to greater resolution and shorter run times. The thin gels also increase sensitivity, thus making analysis clearer. The first generation Heidelberg DNA sequencer was introduced into the market a few years ago by Pharmacia LKB. Ansoerge estimates that it will take about another two years before the faster second generation genetic decoding device is ready for the market.

#### **Germany: Infrared Spectroscopy Applied to Bacteria Identification**

91MI0289 Graefelfing BIOENGINEERING  
FORSCHUNG & PRAXIS in German Feb 91 p 9

[Text] Bacteria can now be identified better and faster than has been possible to date with a new infrared spectroscopy application. A team at the Federal Health Office's Robert Koch Institute in Berlin has announced its discovery that after exposure to heat rays, germs produce typical patterns that are as unmistakable as fingerprints. It has also been possible to reduce the lengthy breeding period of the bacteria from between 18 and 24 to between 6 to 8 hours.

Infrared radiation is the part of electromagnetic radiation invisible to the human eye but perceived as thermal radiation. Infrared spectroscopy, which was developed in 1937, is used to determine the structure and identity of chemical compounds. It is based on the fact that a compound "swallows" a very specific quantity of the irradiated energy. The spectra of the 162 types of bacteria from 25 strains examined each left readily distinguishable curves. The more closely related the types of microorganism, the more closely [the spectra] resembled one another.

Other applications for this method could be epidemiological studies, quality control during the production of pharmaceuticals, rapid pollution detection, and the determination of the germ count in foods. A manufacturer of diagnostic instruments intends to examine the possibility of developing a complete bacteria diagnosis device.

#### **Germany: Special Biotechnology Projects Approved**

91MI0288 Graefelfing BIOENGINEERING  
FORSCHUNG & PRAXIS in German Feb 91 p 8

[Text] Effective 1 January 1991, seven new special research programs were set up at German institutes of higher education. One of the new initiatives is in the humanities, while the remainder pertain to the life sciences. The "improvement of plant cultivation systems with regard to yields and ecological effects" being is addressed by agronomists and biologists at Kiel University. One of the objectives is to calculate the potential

environmental pollution that a given level of production would cause or to calculate the maximum production levels attainable with a given, tolerable, level of production.

Biologists, chemists, and engineers at Berlin Technical University propose to explore the basic principles of "biological treatment of industrial and commercial waste water." In the future, waste water pollutants must increasingly be disposed of at the place of origin, in the industrial and commercial plants, if pollution is to be mastered.

Marburg University's special research program on "intracellular transport and maturation [Reifung] of proteins" will monitor proteins in specific regions of the cell. This entails one of the essential steps of genetic expression, the conversion of hereditary information into "usable" proteins. The special research project can utilize the voluminous preparatory work of the research team on "functional domains of membrane proteins." Cooperation with the Graduate College of Cytology and Tumor Biology recently set up at Marburg University is also sought.

The special research program on "glycoconjugates and contact structures of the cell surface" set up at Bonn University proposes to explore hitherto unknown principles of the organization of nature. This involves interactions between the cells during cell differentiation and the formation of organs. In this process they also form bonding sites for viruses, bacteria, parasites, and poisons.

Physicians, pharmacologists, and biochemists at Erlangen-Nuernberg University are studying "immunological mechanisms in cases of infection, inflammation, and autoimmunity."

Finally, physicians and biologists at Duesseldorf and Cologne universities, the Juelich Research Center, the Max Planck Institute of Neurological Research, and the Ben Gurion University at Beersheva, Israel, are participating in the special research project on "structural changes and dysfunction in the nervous system."

## COMPUTERS

### EC Neural Network Projects Noted

91AN0335 Paris *ELECTRONIQUE INTERNATIONALE*  
HEBDO in French 14 Mar 91 p 21

[Article signed P.A.: "Neural Networks: Europe Is Catching Up"]

[Text] Pygmalion, ANNIE (Application of Neural Networks for Industry in Europe), Galatea: These are the names of programs with which Europe wants to enter the neural network game.

The market for neural networks will multiply tenfold between now and 1995. This is the brilliant future

predicted by most analysts for a sector which should reach the \$1-billion mark in the mid-1990s. Today however, the only truly industrial products are still software products (neural network simulators) and simulation accelerators (additional cards for personal computers or workstations), like those produced by Nestor or Hecht Nielsen, for instance. But because of the extremely rapid evolution of knowledge on formal neural networks, new architectures, and available functions, these products are now lagging behind the latest developments. Only extremely open products, such as user-upgradable ones, have a satisfactory lifespan and are likely to find applications. This is the opinion of the French Advanced Technology Observatory's (OFTA<sup>1</sup>) "Neural Networks" group which met last month to present its synthesis report to the industrial community.

Acknowledging the actual usefulness of neural networks for industry, simulation does not seem the ideal way to benefit from the full potential of neural networks, which is essentially linked to parallelism (speed and possible fault tolerance). A better solution would be to manufacture dedicated machines and application-specific integrated circuits (ASICs). France already has several successes to its credit in this field, such as the 128-neuron "MIND" machine manufactured at the Nuclear Research Center (CEN) in Grenoble. A 1,024-neuron machine is currently being developed.

### Under the Aegis of Thomson-CSF

So-called "neural" research is given much consideration in many countries and, in particular, in several European projects within the framework of the European Strategic Program for Research and Development in Information Technologies (ESPRIT II). The Pygmalion project, destined to produce a "neurocomputer" with its very own language, was allocated a \$6-million budget in 1989-90. Another project, ANNIE, seeks to develop real industrial applications with a \$6-million budget for the 1989-91 period. The Pygmalion project, which is led by Thomson-CSF and in which Philips Electronics Laboratories (LEP), Alcatel SEL, and several European universities are participating, seeks to provide a solid technological basis for neural networks in Europe both at the hardware and software levels (algorithms and applications). Pygmalion is focusing on word and image recognition and, in particular, on real-time image compression technologies for high-definition television (HDTV). This work will be continued for a three-year period within the Galatea project, which aims to develop a "general-purpose neural computer" (GPNC) capable of supporting a wide range of neural networks and a programming environment that suits GPNCs, dedicated processors, and ASICs. The Inmos transputer should fit in nicely here. LEP has also recently used a 64-neuron 1.5-micron complementary metal-oxide semiconductor (CMOS) circuit as coprocessor in one of the French Telmat company's transputer-based Supernode machines.

By way of comparison, in the United States, most contractual funds destined for the development of neural networks come from agencies which depend on the Department of Defense. DARPA spent \$12 million in 1989 and the same again in 1990, while the U.S. Navy has launched a five-year program (until 1994) worth \$18.5 million.

Japan, however, is probably the largest investor in the related fields of biology and neuromimetic architectures. The different national programs total roughly \$10 million per year.

#### Footnote

<sup>1</sup> OFTA's main activity is to organize think tanks on technological subjects considered of strategic importance with a view to presenting useful proposals for the industrial and technological communities.

#### ICL Banned From European IT 'Round Table'

91AN0265 *Amsterdam COMPUTERWORLD in Dutch*  
13 Feb 91 p 4

[Text] ICL was banned from the European Information Technology Round Table, the most influential lobby of the European electronics industry.

The 11 other members of the Round Table argue that ICL no longer fits within an organization aimed at improving the European IT industry's worldwide position. They think it is essential that only "truly European companies" belong to the group. Fujitsu recently acquired 80 percent of ICL. The Round Table was set up in the late seventies on the initiative of the European Commission. ICL, which was one of the cofounders, is now the first company being asked to quit. However, this is not expected to affect ICL's participation in European research programs. ICL continues to be involved in EC-sponsored programs, such as the European Strategic Program for Research and Development of Information Technologies (ESPRIT), the Research for Advanced Communications in Europe (RACE) program, and the Joint European Submicron Silicon Initiative (JESSI).

Its participation in new projects, however, will depend on whether or not ICL is accepted by the other project participants.

#### Germany: Suprenum Supercomputer Firm Restructured

91AN0330 *Edam SUPERCOMPUTER EUROPEAN WATCH in English Feb 91 pp 2-3*

[Article: "Pallas Rises From the Ashes of Suprenum"]

[Text] Pallas GmbH was founded in January 1991 and is located in Bonn, Germany. The company is privately held by the management and employees and will be fully operational in March 1991.

Pallas GmbH starts off with 19 employees, 16 of whom have a scientific university degree.

Pallas is what is left of Suprenum, the German supercomputer company. Its product, the Suprenum-1 did not make much impact and only a few systems were sold and accepted. Suprenum itself lives on as a very small company maintaining these installed systems. The rest of the personnel formed Pallas, a parallel software company, and offers know-how in applications, algorithms, benchmarks, training and consulting to users, programmers and vendors of supercomputers and of highly parallel computers.

The new company cooperates with Meiko, and markets Meiko products in Germany, Austria, and Switzerland. Running on top of the Meiko's CSTools, the Pallas software products have been ported optimally to Meiko systems and are automatically delivered to Pallas customers of Meiko systems.

In cooperation with Meiko and other partners Pallas is developing the European parallel supercomputer Genesis taking the place of Suprenum. Pallas markets and supports high performance parallel computers (currently Meiko's 1860-based systems) equipped with Pallas software products.

Pallas also develops and adapts application software for parallel computers with the emphasis on technical and scientific applications like structural analysis, quantum chemistry, molecular dynamics, computational fluid dynamics, computational fluid dynamics and crash simulations etc. New applications (in medicine, economics, financial management, data bases) will be another field of work.

Pallas offers courses in parallel programming covering the following areas:

- theoretical foundations of parallel processing;—
- overview and evaluation of parallel systems;—
- programming models;—parallel algorithms;—
- practical training on various systems.

Executive seminars, introductory courses as well as four-day in-depth courses are offered. Courses on special applications and special parallel systems are also planned.

#### Consulting

The purchase of a parallel computer is a complex matter. Many vendors offer systems with different principles of operation (SIMD, MIMD, SPMD) and programming models. Neither does a common language standard exist, nor is a generally accepted benchmark suite available for parallel machines. All these aspects make comparison difficult. Peak performance statements have to be judged with regard to the intended applications. Pallas should have an excellent knowledge of parallel systems on the market and is thus able to:

—provide market overviews;—evaluate system options by conducting benchmarks;—carry out feasibility studies for code parallelization.

### **University of Stuttgart Installs MT-1 Supercomputer**

91AN0329 *Edam SUPERCOMPUTER EUROPEAN WATCH in English Feb 91 pp 1-2*

[Text] The University of Stuttgart has purchased an MP-1 massively parallel computer system for its Institute of Parallel and Distributed High-Performance Systems (IPVR). The MP-1 system will support the university's work in developing an advanced parallel programming language and applications such as a database system, neural networks, parallel image generation and sorting algorithms. Other work includes researching fault-tolerance in parallel systems, creating a real-time simulation environment for large neural networks used in image recognition, and producing development tools for parallel programming.

IPVR will use the MP-1 in their effort to develop an advanced version of a machine-independent parallel programming language called Parallaxis. Parallaxis is designed to be portable across various platforms of massively parallel SIMD (single-instruction multiple-data) computers.

"We are looking forward to using the MP-1," says Andreas Reuter, director of the IPVR. "The MP-1 is essentially a very high-performance supercomputer, priced in the range of minicomputers, that is easy to program and maintain. We have chosen the MP-1 as the platform on which to conduct our leading-edge research and teaching."

The University of Stuttgart's purchase of the MP-1 represents MasPar's first sale in Germany from its newly established Burgwedel office. MasPar's German sales and operations will be managed by Werner Butscher.

### **Netherlands: SBI '91 Private Industry Subsidy Program**

91AN0266 *Amsterdam COMPUTERWORLD in Dutch 13 Feb 91 p 16*

[Article: "4.5-Million Subsidy for Computerizing Industry Sectors"]

[Text] Just like last year, Minister Andriessen launched a subsidy scheme for the promotion of information technologies, called SBI '91. These subsidies are intended for collective, sector-oriented projects, which aim at promoting the use of information technology in private companies. SBI '91 is a follow-up program to a similar scheme from 1990, which has so far benefited more than 90 industry sectors. SBI '91 differs from the 1990 scheme in two ways. This year, cooperative bodies involving various sectors or three or more companies from the same industry sector can also request subsidies. As a

result, more activities become eligible for subsidies, such as awareness campaigns, demonstrations, the setting up of information frameworks for specific industry sectors, standardization, and system evaluations. A budget of 4.5 million guilders is available for subsidy requests. The subsidy will cover 50 percent of the external expenses, with a ceiling of 500,000 guilders.

## **DEFENSE R&D**

### **Western European Union Proposes Military Satellite Network**

91MI0299 *Rome AIR PRESS in Italian 3 Apr 91 p 759*

[Text] It will take five years and 5 billion lire to create a European agency for military remote surveying via satellite to oversee, control, and monitor disarmament. The absolute necessity for Europe to be completely independent in this area was underlined by parliamentarians at a two-day conference in Palermo on the future of the WEU (Western European Union), the European defense organization (made up of Belgium, France, Germany, Italy, Luxembourg, the Netherlands, Portugal, Spain, and the UK).

"The Gulf experience," stated the president of the WEU's aerospace commission, Bruno Stegagnini, "demonstrated the urgent need for the European countries that placed their naval units under the control of the WEU to have a satellite information system for real command and control. It was the very lack of this system," he added, "that forced us to place our ships under the control of the United States."

Apart from the need to have a control center for the international crises that may arise, the WEU aerospace commission, which will provide the association's council of ministers with suggestions, has also shown how a satellite agency is indispensable in controlling and monitoring the disarmament process in Europe. The worry of the WEU is that this project will be misinterpreted by the general public: "This does not mean militarizing space", noted Stegagnini, "or activating spy satellites, but creating a trustworthy model that will enable us to monitor disarmament, and on this point we also have the full support of the Soviet Union."

The costs of the project will be divided proportionally among the nine WEU countries which, in addition to the start-up and management phase, will have to establish ground stations and a data processing system to make all the information collected by the satellites available in real time. One of the points of discussion was the problem of integrating the optical remote surveying system with the radar system, for which both Germany and Italy have the technology according to the president of the WEU aerospace commission. This link-up is indispensable for observations under all weather conditions, both night and day. For the development of this ambitious program, the creation of a consortium among the major European and national space agencies is

practically a foregone conclusion. Once in operation, the satellite network could also be used for civilian purposes, such as environmental protection and civil defense, and all public and private bodies will be able to subscribe to this service.

### European Missile Agreement Signed

91WS0182C Paris LE MONDE in French  
7 Feb 91 p 11

[Article: "Four European Countries Join in Surface-Air Missile Project—Great Britain, Spain Join EUROSAM [European surface-to-air missile] Program"]

[Text] France, Great Britain, Italy, and Spain have signed a memorandum of agreement to study and develop jointly a new surface-air-missile system for zone-defense. The defining of this system is expected to take two years. The agreement was signed in January, but was not disclosed until 5 February, when its existence was revealed by a British source.

Prior to this agreement, France and Italy had already formed a joint venture, designated EUROSAM, and launched the development of a missile, the Aster, for which the prime contractorship is being provided by France's Aerospatiale group, with participation by Italy's Selenia firm. The Aster is being developed as a medium-range, surface-to-air, anti-aircraft missile with anti-missile capabilities, in two versions. An initial version is the Aster-15 for ground-launched surface-to-air defense. The second version, Aster-30, is to equip, in France's case, the "Charles-de-Gaulle" aircraft carrier currently under construction, as well as the French Navy's new anti-aircraft frigates.

Great Britain and Spain, for their part, were originally interested in a similar NATO project. They have now joined the EUROSAM program, with a view to deriving from it a weapons system for their own navies, based on the Aster-30 version. But the French and Italians do not exclude the possibility that the British and Spaniards may also decide to join the Aster-15 project.

## ENERGY (ALTERNATE)

### Germany: Service Stations of Future Underway

91P60176 Leipzig ENERGIE TECHNIK  
in German Apr 91 p 155

[Excerpt] [Passage omitted] Even in Berlin, work is proceeding on solar service stations for the electrically-powered automobiles of the future. At the Technical University of Berlin, in an EC concept study, Professor Dietrich Naunin has developed a fuel pump, for electrically-powered automobiles, which incorporates all sorts of computer intelligence. Unlike coin-operated pumps, the Technical University's service station—which can be powered either by a public network or by solar cells—dispenses current only when the customer inserts a

magnetic card, similar to a card-operated PTT telephone. When several services stations in a city are combined into a network, central programming can vary the price of electrical current in relation to peak periods or by district. So, those coming into the city around noon are obliged to pay more for electrical current. This project, [developed] by electrical engineers at the Technical University is complete as a design and will soon be implemented as a prototype.

### Germany Increases Wind Power Program Funding

91MI0257 Bonn TECHNOLOGIE-NACHRICHTEN  
MANAGEMENT-INFORMATIONEN in German  
28 Feb 91 pp 10-11

[Federal Minister of Research and Technology Directive on funding for testing "250 MW Wind" wind power plants under the third Energy Research and Technology Program, dated 13 February 1991]

[Text]

#### 1. Purpose of Grants

The "100MW Wind" Directive on the funding and testing of wind power plants issued on 4 June 1989 aroused great interest. Just over a year later, applications totaling more than 100 MW had already been submitted. It has therefore been decided to step the "100MW Wind" funding measure up by 150 MW to 250 MW.

The law on feeding power from renewable energy sources into the public supply grid (the power input law) came into effect on 1 January 1991. It provides for an increase in the allowance for electricity generated from wind and other sources. The regulations set out in this directive concerning the type, scope, and level of the grant have been adjusted to comply with this law.

The purpose of the "250 MW Wind" funding measure is a major multiyear experiment to test wind power on an industrial scale. Within the next five years total installed capacity of 250 MW will be achieved, where possible based on the original "100 MW Wind" funding measures.

The funding is designed to encourage a larger number of demonstration users to install and operate wind power plants at appropriate sites throughout the Federal Republic of Germany. This will produce statistically relevant information on the operation of wind power plants in the Federal Republic of Germany.

For this purpose, for a maximum of 10 years from the entry of a wind power plant into service, commencing no earlier than the start of the approval period, in accordance with this directive and the provisional administrative regulations on Sections 44, 44a of the Federal Budget Regulations (BHO), the BMFT [Federal Ministry of Research and Technology] awards grants in the form of a subsidy per kilowatt hour (KWh) generated, up to a maximum sum, or, if preferred by particular groups of

participants, in the form of an investment cost subsidy. The BMFT is also financing a scientific metering and evaluation program (WMEP).

The grants will be awarded in accordance with the budgetary funds available. There is no legal right to a grant; instead the approval authority will decide on the basis of its due discretion.

## 2. Nature of Funding

Funding will be granted for the installation and operation of wind power plants on appropriate sites in the Federal Republic of Germany.

## 3. Grantees

Private individuals, partnerships, legal persons under private law, corporations, and statutory bodies resident or having their head office in the Federal Republic of Germany are eligible to apply.

## 4. Prerequisites for Grants and Approval Criteria

4.1 A grant will only be awarded for the erection of new wind power plants with an output of at least 1 KW at a wind speed of 10 m/sec. Projects begun before the month in which the application is submitted cannot be funded.

4.2 The following criteria in particular will be considered for approval purposes:

- technical maturity, development status, and test requirements of the type of plant concerned;
- test requirements of the chosen site (variety of different sites);
- contribution to the further development and enhancement of the technical level of German wind technology research and development.

4.3 Further prerequisites for a grant are that the applicant must declare willingness to participate in the WMEP and that the planned wind power plant must fulfill the technical conditions for inclusion in the WMEP, in particular generating grid-compatible alternating current.

## 5. Type, Scope and Level of Grants

5.1 The grant will be awarded as a nonreturnable subsidy under project funding.

5.2.1 Grants taking the form of an operation cost subsidy are commensurate with the amount of power generated. It amounts to 0.06 German marks [DM] per kilowatt hour of electricity generated and for which a grid input allowance can be claimed within the payment period, and DM0.08 per kilowatt hour of electricity generated for which no grid input allowance can be claimed within the payment period. Payment is made once a year for the previous year on presentation of an annual report (log-book), as specified by the WMEP, and an attested meter reading.

5.2.2 There are restrictions on the level of grants. Operating cost subsidies will no longer be payable when the total made up of electricity consumption charges avoided, grid input allowance, and subsidies and supplementary payments from public funds (including the European Community) reach twice the amount billed for the wind power plant (including installation on the existing foundation). Calculations are based for these purposes on the data stated and acquired under the WMEP.

5.3 In place of an operating cost subsidy as per paragraph

5.2.1, an applicant may apply for a single investment cost subsidy if the wind power plant is not part of the business assets of a commercial company. Wind power plants belonging to farms or farming consortia and/or nonprofit associations are not regarded as business assets. Public services may apply for funding under paragraph

5.2.1. The following formula is used to calculate the investment subsidy:  $\text{subsidy in DM} = \text{hub height in meters} \times \text{rotor radius in meters} \times 400$ . It may, however, exceed neither 60 percent of the amount billed for the wind power plant (including installation on the existing foundation) nor DM90,000. An equivalent subsidy will be granted for nonhorizontal axis machinery.

5.4 In the event of a substantial change in the economic conditions for the construction or operation of wind power plants, the BMFT reserves the right to modify funding conditions for new awards accordingly; grants that have already been awarded will not be affected.

5.5 Individual wind power plants for which other funding has been or will be obtained from the BMFT or under the joint [federal/land] project to enhance the structure of agriculture infrastructure and protect the coast will not be eligible for additional funding under this program. Prototypes are not covered by this funding scheme.

5.6 Applications for grants unlikely to exceed DM3,000 will not be approved (threshold value).

## 6. Other Rules Governing Grants

The payment of grants awarded under paragraphs 5.2.1 and 5.2.2. is governed by the BMFT's 250 MW Wind/B collateral provisions and those awarded under paragraph 5.3 by the 250 MW Wind/I collateral provisions for this project. The obligations inherent in participation in the WMEP, applications for grants, and the Federal Audit Office's right of inspection are also governed by the collateral provisions. Factors relevant to subsidies within the meaning of Article 264 of the Penal Code are specified in greater detail in the application forms.

## 7. Procedure

The Federal Minister of Research and Technology has delegated the Juelich Research Center GmbH Biology, Energy, Ecology (BEO) Project Manager P.O. Box 1913

5170 Juelich 1 Tel. (0 24 61) 61 32 52 to handle these funding measures. In particular, it is incumbent upon the project management to provide information on the funding measures, examine the applications, advise whether or not to grant funding, and handle correspondence for the BMFT. The project management has the right to require additional information concerning the applications and the grantees' handling of the funding.

Applications may be made from this date until 31 December 1995. Should an application for additional funding be made to a land, the applications to the land and federal government should be filed simultaneously with the Juelich Research Center GmbH and the appropriate land authority.

The BMFT will decide whether or not to award a grant following discussion with the land involved.

The provisional administrative regulations on Articles 44 and 44a of the Federal Budgetary Regulations shall apply to the approval, payment, and calculation of grants, to the proof and checking of their use, and, if necessary, to the repeal of the decision to award a grant and the demand for repayment of the grant awarded, unless otherwise provided in this funding directive.

#### 8. Transitional Arrangement

Duly completed applications received before 1 January 1991 will be processed in accordance with the previous directive on funding the "100 MW Wind" wind power plant trials as part of the second energy research and energy technology program.

#### 9. Entry Into Force

This directive will enter into force on 1 March 1991.

The "100 MW Wind" directive of 24 May 1989 on wind power plant funding and trials under the second Energy Research and Energy Technology Program will be repealed with effect from 28 February 1991.

Admendmentments will be announced in the Federal Bulletin.

Bonn, 13 February 1991  
The Federal Minister of Research and Technology  
by order  
Dr. Bauer

#### German-Spanish Asterix Program Furthers Solar Energy, Chemical Processes Research

91WS0213A Duesseldorf VDI NACHRICHTEN  
in German 1 Feb 91 p 23

[Article by Andrea Steinert: "Sun Finding Its Way Into the Test Tube"; first paragraph is VDI NACHRICHTEN introduction]

[Text] Madrid, 1 Feb (VDI-N)—Chemistry should open new applications for solar energy. Asterix is delivering its

first findings. Solar chemistry—behind the term is the desire to use the sun as an energy source for chemical processes. In Almeria, Spain, the DLR [German Aerospace Research Institute] has begun an experiment in this area.

The flame is virtually colorless. And your eyes blink, dazzled, into the bright blue sky as they attempt to make out the illusive contours—yet on an opposing metal collector the heat is projected in outward moving shapes.

What is burning here at a height of approximately 80 m on a solar tower on the edge of a field of solar collectors under the southern Spanish sun is synthesis gas—a quite common basic material for the chemical industry, which can be obtained by reforming methane. The experiment definitely has international significance. It is intended to demonstrate that solar energy can be fed into an important chemical process, methane reforming in this instance, instead of using gas, oil, or nuclear energy.

"Internationally, this is the first test to break out of the laboratory," reports Dr. Manfred Boehmer of the German Aerospace Research Institute (DLR) in Cologne-Porz. He is the project leader for the Germans. The DLR and Ciemat (Center for Energy, Environment, and Technical Investigations) in Madrid are participating fifty-fifty in this 1.6-million-German-Mark [DM] project called "Asterix". Asterix is the acronym for "Advanced Steam Reforming of Methane in Heat Exchange".

Project experiments have been underway since last October and are planned to continue through the middle of this year. A team of a total of 13 Germans and Spaniards takes turns looking after the project on the "Plataforma Solar de Almeria", a German-Spanish test center in Andalusia. In the past years, among other things, a solar tower installation essential to the project (solar collectors with a solar tower) has been established here.

"Since electrical current can only be transported economically for a few hundred kilometers, in Germany it is possible for us to use solar energy on a large scale only if it is transformed chemically," believes Boehmer. However, in contrast to the generation of solar power, solar chemistry is largely new territory. With Asterix two objectives are currently being pursued: On the one hand, characteristic problems arising in the manufacture of a product with solar energy are to be solved using a process familiar to the chemical industry. On the other hand, the researchers are investigating the conditions under which solar energy can be stored and transported.

The example of methane reforming was an obvious choice since it is a heavily endothermic reaction, i.e., one in which energy added in the form of heat can later be released via a reverse chemical reaction. The significance: With such an intermediate step, solar energy can be used at any location. With these experiments the team is also feeling its way into the problematic production of

hydrogen. Many see the solution of the energy problem itself in this energy medium.

The real goal of the researchers is thus to modify the familiar production process on the basis of this new energy source, sunlight, which is not equally available everywhere, i.e., to factor in clouds and darkness. Since in the past it was no longer possible to continue production with a constant temperature, e.g., exactly 820 degrees C—Asterix should demonstrate that the sun can nevertheless deliver the necessary energy.

Thus far, the tests have shown that the newly developed "steam reformer"—a system adapted to the sun as its energy source and in which the reaction takes place—functions well under constant temperatures (stationary conditions). It can produce high quality synthesis gas. In the coming months the team will investigate the quality of synthesis gas obtained under fluctuating temperatures.

The DLR project leader feels that temperature fluctuations can, in principle, be brought under control. For example, because of its large size and by means of insulation, the reformer will lessen fluctuations. Also, if the synthesis gas is not used immediately, a storage tank will compensate for different compositions.

Heat accumulators, for example, a boiler filled with ceramic masses, or a fossil heater, could offset dropping temperatures, if this expense is justified. But, above all, according to Boehmer, industry is urged to develop processes which are less dependent on constant temperatures than in the past.

The steam reforming process in Almeria consists of two closed cycles linked via a heat exchange process: One air cycle which provides the heat for the reaction and which was developed in a past project under the name "GAST" (Gas-Cooled Solar Tower) as well as the reaction of steam and methane to which the Asterix project is specifically devoted. The necessary heat for the reaction is thus transferred by convection (through gas) rather than by radiation (open flame) as is conventional.

The steam reformer is approximately 7 m tall and has a total diameter of about 80 cm. It is located above the collector on the platform of the solar tower. Commercially available nickel-plated Raschig rings serve as the catalyst supporting the reaction in the reformer. The molar ratio of steam to methane is three to one. Among other things, the series of test should reveal the optimum relationship between temperature, pressure, and the steam: methane ratio. The 50 kg of synthesis gas recovered per hour is analyzed with a gas chromatograph and then burned off—thus far unused.

Experts warn against expecting too much from solar chemistry in the short term. It is still "essentially in the pure research stage". The next step would have to be actual construction of solar tower power plants on the industrial scale, with a capacity of from 30 to 100 MW.

The power plant in Almeria has a capacity of approximately 1 MW. Jose Antonio Rodriguez Povedano, Spanish test director at Almeria, thinks it will be 20 to 30 years before systems like that used in the Asterix project will operate on a larger scale.

## FACTORY AUTOMATION, ROBOTICS

### Backpanel Bus Systems in European Factory Automation Discussed

*91WS0200A Paris INDUSTRIES ET TECHNIQUES in French 8 Feb 91 p 34*

[Article by Mirel Scherer: "The VME Bus Gives Voice to Machines"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] The VME backpanel bus is becoming a must in automation. Its potential uses cover a vast area, and new products such as devices for vocal command of robots are appearing. A report from the VME colloquium (Mayence).

The VME backpanel bus has had spectacular success, and the number of its applications is growing daily. While users wait for the VMEbus to become the Futurebus+, which should happen sometime between 1995-2000, they are voting overwhelmingly for the boards. This is especially true in factory automation, where they are proving irreplaceable. The Mayence conference at the end of November surveyed the product's uses. The VMEbus played a major role in the automation of the Vienna (Austria) Philips factory, which manufactures 1.8 million tape recorders a year. The standards-conformity test and adjustment station at the end of the assembly line was based on the VMEbus. It takes only six seconds for its components (assisted-vision module, signal-processing processor, real-time processor, and handling module) to perform their operations. The advantages of the approach include improved and more consistent quality, a checking and adjustment time that is reduced by a factor of four, and increased flexibility.

ENEL, the Italian equivalent of EDF (Electricity of France), is collaborating with the Cesi Company to implement a monitoring and diagnostic system for a high/average voltage transformer plant. In this case, the VMEbus links three distinct units: the data-collection unit, the central real-time processing unit, and the AT PC data-storage unit that also functions as the interface with the operator.

There has been a good harvest of VMEbus products as well. An example is the Eurolog-IIS (industrial interface system) designed by the German company EBV Mikrosystem. "The use of a VMEbus-based computer to automate an application requires an industrial input/output (I/O) system capable of interfacing with the process," points out Harald Borger (EBV Mikrosystem).

### **RISC and CISC: A High-Performance Foundation for Automation Products**

"Usually, we use a VMEbus board or a programmable automaton for that purpose." Eurolog-IIS, a more modern solution, involves setting up a distributed I/O subsystem, whose advantages for industrial automation are substantial. Its assets include easy configurability as a result of software stored in the central computer's program, direct access to I/O signals, error-diagnosis help, and compactness, among others.

The VMEbus also proved its worth in the automatic voice recognition system for robot control developed by Paderborn University (FRG) researchers. The system has a four-second recognition time for a vocabulary of 200 words. Actually, the vocabulary is split into several groups of words activated as the need arises. The group must be chosen at a certain, calculable speed: If the size of the vocabulary is 50 Koctets and the group's maximum transfer time 0.25 seconds, transfer speed will be 200 Koctets/second. Themis Computer has also introduced a robot application. Devised by the Annecy LAMII laboratory, Symphir identifies the dynamic parameters of industrial robots. Real-time functions are performed by a VMEbus system designed by Themis and linked to a Sun station. The latter provides man/machine interface and processes the data in masked time.

Colin Davies, VMEbus product manager at Radstone, outlined future developments while stressing the contribution of the new RISC (reduced instruction set computer) and CISC (complex instruction set computer) processors. Used in advanced architectures, these microprocessors will form a high-performance foundation for automation products. "That is in addition to the progress in software maintenance, which will have a positive effect on the cost of future VMEbus systems," he concluded.

### **Austria: Parallel Computers Control Industrial Processes**

*91WS0309A Duesseldorf VDI NACHRICHTEN  
in German 5 April 91 p 22*

[Article by Wolfgang Mueller: "Parallel Computer Controls Industrial Processes"; first two paragraphs are VDI NACHRICHTEN introduction]

[Text] Duesseldorf, 5 Apr—The data bus can become a bottleneck. Austrian firm takes a new route to automation.

Parallel computers composed of multiple transputers are increasingly developing in industrial uses as an alternative to conventional multiprocessor controls. Wherever high performance computing and real-time processing are needed, they can be used cost effectively, as was demonstrated at the Hannover Industry Trade Fair.

In the control of complex processes a great number of difficult problems emerge for the industrial user: many

sensor and actuator channels, high scanning frequencies, preprocessing, and linkage. Regulating dynamic cycles seems equally problematic. High calculational outputs are required for the coordinated movements of multiple axes, for example, in robots. Image processing in industrial applications demands the machine speed evaluation of measured values captured without contact.

The source of many difficulties lies in the use of bus-based systems with few processors. Generally, only one such switching point is included in a control system. "These systems are well suited for simple and readily comprehensible problems," states Dr. Ralph Foehr, director of systems development at the Aachen parallel computer pioneer Parsytec, "however, for complex solutions they are inadequate: The bus becomes a bottleneck, resulting in a jam of data." Overloading of the single processor and the lack of overlapping programming of several processors in conventional bus-based systems are the result. Foehr's alternative for the solution of this problem is a transputer-based parallel computer.

In 1985, the British firm Inmos Ltd, which has since merged into the Italian-French chip manufacturer SGS-Thomson, introduced a new processor: the transputer. It has little in common with a conventional microprocessor—the heart of computer and machine control. On the contrary, the "transaction computer" is more of a complete microcomputer. The Inmos T800 transputer, for example, has a 32-bit Risc architecture and also has a 64-bit floating point unit (FPU), which gives it a performance of 2.25 mflops (million floating point operations per second) in arithmetic operations. It also has a faster internal memory (RAM) of 2 or 4 kbytes, a programmable MMU (memory management unit) for connection of different memories, and 2 x 4 communications channels (DMA links) each with transmission speeds up to 20 mbps.

These links are a simple means of implementing data exchange and synchronization between processes running in parallel on different transputers. Via them, the minicomputers can exchange data among each other without the processors having to discontinue their other activities, as is the case with conventional processors. By means of this linking capability, with which approximately 7.2 mbytes of data can be transmitted per second, transputers are predestined for incorporation into parallel computers.

### **From Computer Manufacturer to System Supplier**

In the past, the Aachen super star Parsytec has primarily supplied such extremely high performance parallel computers. At this year's Hannover CeBIT Trade Fair, the company is also now presenting itself as a supplier of transputer-based real-time industrial applications. According to Parsytec chairman Falk D. Kuebler, "We

have transformed ourselves from a computer manufacturer into a systems supplier." With I/O cards, analog-to-digital converters, high speed interfaces for data transmission, and bridging modules for linking to industrial bus systems, Parsytec is building complex control systems for industrial use.

For three years, the automation specialist G. Bachmann Electronic GmbH in the Austria town of Feldkirch has also been working on these problems. At the Hannover Industry Trade Fair the company presented for the first time a complete automation system consisting of standard modules with a transputer CPU as its heart. The 19-inch system box of the transputer control system TC 600 contains slots for 18 single European boards. A group of fast I/O modules without their own intelligence—which can thus be manufactured cost effectively—are available. The conversion times of the analog cards are in the microsecond range and are thus also exceptionally fast.

The key to the success of transputer-based parallel computers lies above all in their operating system. At Bachmann Electronic GmbH, recently recognized as an innovative Austrian firm with the Alpenland State Prize, a real-time multitasking operating system has been developed for the automation system. "Development of our own operating system was essential because Helios, the standard operating system for transputers, is not yet advanced enough in its real-time capabilities," according to company chairman Gerhard Bachmann. His automation system is a complete solution with comprehensive hardware and software. It also includes, in addition to the TC 600 controller, process visualization using a man-machine interface—a compatible industry laptop with color LCD—and graphics visualization software.

Using a plug-in board, the controller can be networked with the lead computer level via a standard field bus (Profibus). The system thus becomes CIM capable. "With our complete solution consisting of transputer control, visualization terminal, and software, we have a unique system," the obviously proud founder of the company, Bachmann, is pleased to report. "We can use them virtually everywhere, from the small SPS task to process control engineering."

#### **France's ONERA Develops Ultrasound Abrasion Machining Process**

91WS0219B Paris L'USINE NOUVELLE/  
TECHNOLOGIES in French 14 Feb 91 pp 11-12

[Article by Marc Chabreuil: "Ultrasound Abrasion, a Hope for Industry"; first paragraph is L'USINE NOUVELLE/TECHNOLOGIES introduction]

[Text] This high precision machining process conquers both very hard and very fragile materials. Companies are eagerly awaiting it.

A new machining technology is about to reach industry: ultrasound abrasion machining. Some 10 major French

and foreign companies have already asked the National Office for Aerospace Studies and Research (ONERA), which invented the process, to run feasibility studies on complex parts. One of them is even thinking of using this technology to manufacture millions of parts. More generally, the aerospace and automotive industries, inertial systems makers, mold and electrode manufacturers, and glass makers, among others, have shown an interest in the process.

"Ultrasound abrasion will not replace traditional machining techniques. It will only catch on where the traditional processes are inoperative or poorly suited," according to Alain Bernard, the head of ONERA's electronics and measurement department. ONERA is in a good position to say so. It developed this technology because no traditional process was precise enough to groove and recess the sheets of titanium ceramic glass used for the electrodes in Gradio, a  $10^{-11}$  ms<sup>-2</sup>-resolution accelerometer that may be launched into space in 1997.

Ultrasound abrasion is particularly suited to the machining of very hard materials (such as sapphire, ruby, silicon carbide, and all the new experimental materials) and very fragile or delicate materials (such as glass, alumina, ceramics, and ceramic glass). Silicon is also a candidate, since, while chemical machining barely exceeds 0.5 mm, the ONERA process makes it easily possible to achieve 2 mm. This same goes for graphite, which, although easy to machine, requires frequent cleaning of the machine and replacement of tools. Lastly, ultrasound abrasion can be substituted for electroerosion with all nonconducting materials.

The secret of ultrasound abrasion is a very hard tool (carved from a polycrystalline diamond block) that does not wear out. With punching, for instance, this avoids leaving the stamp of a worn-down tool. As a result, machining precision is constant, and retooling does not require readjusting the settings. Also, abrasion machining is easy to automate to the extent that it is relatively slow: 1.5 m/minute in silica and 4 to 5 m/minute in graphite. In fact, obtaining a groove 1 mm wide and 1 mm deep in tungsten carbide takes the same time as with electroerosion. However, cutting a 1 mm hole will only take 50 minutes instead of 5 hours.

"By moving the part in front of the tool, we can create the shape we want," Alain Bernard said. On an experimental basis, ONERA has produced an alumina hemisphere with a sphericity of 30  $\mu$ m by programming 1  $\mu$ m increments. It has also threaded glass sheets and has machined a screw/nut set from silicon carbide. All this was done with "simple" three-axis digital control.

Precision is obviously a function of both the abrasive used and the material. "Overall, we get 20  $\mu$ m for rough forming and from 2 to 5  $\mu$ m for finishing. Roughness depends on the same factors. Nevertheless, we have obtained 0.1  $\mu$ m with very hard materials," Alain Bernard said. "The goal is to reach the nanometer requested

by many manufacturers," he continued. ONERA specialists will be focusing their efforts on that goal this year.

ONERA is willing to let manufacturers take advantage of its know-how. However, the future of the process is in the hands of its license holder, Sonex Service SA, a subsidiary of Extrude Hone. "We are ready to graft the ONERA "inventions"—filtering ultrasound to preserve the guides, three-axis control, and, above all, using highly sensitive capacitive force sensors to regulate the thrust of the head—onto our one-axis ultrasound machines. However, given the additional cost—almost 400,000 francs, or 50 percent—and the fact that the system is not universal, we believe that, for now, the market is limited to research centers and the military," according to Daniel Kremer, a Sonex advisor and a professor at Industrial Arts and Crafts. Besides, the first order, expected before next June, will reportedly come from a military research laboratory!

**France: Dassault Robot Prepares Machining Tools**  
*91WS0219A Paris TECHNIQUES & EQUIPEMENTS DE PRODUCTION in French Feb 91 p 14*

[Article by A.K.: "The Robot Prepares the Tools"; first paragraph is TECHNIQUES & EQUIPEMENTS DE PRODUCTION introduction]

[Text] Machining aeronautic parts requires the use of many cutting tools. To assemble these tools, Dassault uses a robot that will pay for itself in three years.

Another application has been found for industrial robots: assembling and disassembling cutting tools. The new robot unit currently being tested is part of a longer-range (five- or six-year) project designed to achieve fully automated tool handling at the Dassault machining shop in Seclin.

With 29 digitally controlled machining tools working around the clock at close to 90 percent of capacity, the plant uses a lot of cutting tools. The new unit will make it possible to handle 5,000 of the most often-used milling cutters, the 19 tapers, and the 12 pulls without changing grippers. It receives the tools used from the shop, separates the three components, and stores them in their respective bins. The procedure is reversed when the shop requests new tools.

The installation centers around a Cincinnati Milacron four-axis T3 robot equipped with a pneumatic gripper with fiber-optic sensors. The robot is surrounded by the tool assembly and disassembly stations. It begins by placing the milling cutter and its tool holder in front of a bar-code reader for identification. It then places the assembly on a station, where the pull is removed pneumatically. The remaining components go on to the next station, where the cutting tool and taper are unscrewed.

The unit, which was developed by Dassault robotics experts, is designed to operate 3,150 hours a year, which

represents some 63,000 assemblies and disassemblies. With one operator per shift to operate the unit (instead of the three operators previously needed), Dassault expects a return on its investment in three years.

Other developments are planned. Dassault intends to automate the transfer of milling cutters between the robot unit and the regrinding machines in about two years. In five or six years, the computer system that controls the unit and the plant will be integrated.

## LASERS, SENSORS, OPTICS

**Germany: Siemens Probing Electrical Power Transmission via Fiber-Optic Cable**

*91P60155 Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 23 Apr 91 p 8*

[Text] At Siemens AG's Nuernberg research laboratories, Munich/Berlin, using a high-power diode array as a transmitter and GaAs photoelement arrays as a receiver, a power supply module was built which can transmit 120 milliwatts (mW) of electrical power, at a voltage of around 7 volts (V), over a ten-meter length of fiber-optic cable. The firm expects considerable advantages from the [use of the] module in the presence of strong perturbing electromagnetic fields and in the high voltage region.

Such power supplies could be used, for example, for operating sensors. Apart from providing power, signal transmission via fiber-optic cable is also possible, thereby doing away with all electrical connections to the testing station. According to Siemens, a test is currently in progress at Badenwerk AG, where delivery of power to a current converter at a high voltage potential of 400 kilovolts (kV) is being tested.

A high-power laser diode array, manufactured in the semiconductor sector of Siemens AG and having 40 strips and a maximum optical power output of a watt (W) serves as the transmitter. It is connected to a "pigtail" about a meter long, from which light is fed into a 300-micron stepped index quartz optical fiber. A GaAs-based multi-photoelement array, also manufactured in the semiconductor sector and having an edge length of around 2 mm, again converts the light into electric current. This array consists of a 4 x 8 [matrix of] individual elements, in part connected in series for increasing the output voltage. Siemens reports that, for an optimal cone of illumination incident upon the multiphotoelement array, an efficiency of more than 30 percent was achieved for the optical/electrical conversion.

At peak electrical power and for a transmission [cable] length of 10 m, the complete system achieved an efficiency of around 2 percent. Overall efficiency drops off as the length of the fiber-optic cable increases. Despite that, for an attenuation factor of 6 decibels per kilometer

(dB/km) for the light in the fiber-optic cable, delivery of over 100 mW of power over several hundred meters can be achieved.

#### France: New Laser Material Under Development

91AN0338 Paris FRENCH TECHNOLOGY SURVEY  
in English Feb-Mar 91 pp 17, 18

[Text] Dye lasers have the advantage of being tuneable, but the drawback of requiring the active molecules of the dye to be in solution in a circulating liquid, a system usually cumbersome and costly.

Researchers at the University of Montpellier II CNRS (National Center of Scientific Research) unit have managed to produce a silica sol-gel containing the molecules of these dyes.

The sol-gel is obtained by gelifying an organic solution containing the silica precursors. Condensation ends before the density of glass is reached. The final product, of good optical quality, contains microscopic pores in which the dye molecules are trapped. The pores are very small and contain a few molecules at the most, and perhaps only one.

At the Orsay Institute of Theoretical and Applied Optics, these special solids have been used for producing completely solid dye lasers (using sulpho-rhodamine 640). It then appeared that the interactions between the dye molecules and the silica matrix allowed the laser to be tuned over a broader range of wavelengths than with the dye in solution. This broad band makes it possible to amplify ultrashort light pulses whose spectral range is more extensive as they are of shorter duration.

It seems unlikely that high power solid dye lasers will be made in the near future because the dye loses its properties as a result of the heat given off. For the moment, applications are limited to pulsed lasers.

Current research is following a number of avenues:

- Inclusion of new dyes capable of covering the entire visible spectrum and the near infrared;
- Inclusion of saturable dyes such as malachite. The solid very quickly becomes opaque when light passes through it, allowing only a very short pulse to pass;
- Inclusion of highly non-linear molecules;
- Understanding the interactions between the dye and the silica matrix with a view to optimizing performance.

## MICROELECTRONICS

### EUREKA: 3-D Integration Project Outlined

91AN0336 Paris FRENCH TECHNOLOGY SURVEY  
in English Feb-Mar 91 p 3

[Article: "Industrialization of a Technique for Producing Multi-Layer Ceramic Substrates"]

[Text] The GRETA (GREen Tape Automation) project will produce multi-layer ceramic substrates for hybrid electronic circuits to be used in industrial applications in motor vehicles and telecommunications. The objective of this EUREKA programme is to considerably increase the integration density while reducing costs by introducing a new 3-D interconnection technique highly suited to automation, involving the process known as low temperature curing.

Three European companies are taking part:

- SOREP SA (France), main contractor: This is a microelectronics service company specializing in the design and production of high performance hybrid integrated circuits and in producing, simulating and testing monolithic application-specific integrated circuits (ASICs). This company also has a basic experience with the low temperature curing technique;
- Siegart GmbH (Germany): Apart from manufacturing hybrid circuits, this company is developing biosensors for applications such as blood testing, pollution, etc.;
- Baccini SRL (Italy): A company producing systems and installations for electronic components. It specializes in the production of automatic printing machines for hybrid circuits, laser systems for cutting, pre-cutting and drilling substrates, curing furnaces and so on.

The Du Pont de Nemours company, for its part, supplies the three partners with the basic materials as well as technical support in the field of materials and special processes.

The close cooperation between the different partners should result in the industrialization of the 3-D multi-layer interconnection technology, and the design and installation of two automated industrial production lines with systems for software and mechanical interfacing.

### ESPRIT II Project Produce Advanced Workstations

91AN0318 Amsterdam COMPUTABLE  
in Dutch 22 Feb 91 p 5

[Text] Brussels—The ESPRIT II project "SPIRIT" is expected to produce the first tangible results some time this year—during the third quarter, according to observers. This was reported by the British newsletter COMPUTERGRAM.

The project, which is being conducted within the framework of the European Strategic Program for Research and Development in Information Technologies (ESPRIT-II), is to produce a number of system models.

The first model is SPIRIT-0, a workstation which can accommodate up to 12 Motorola 68040 processors interconnected via a VME bus. The use of these processors provides the system with a processing capacity of roughly 90 million instructions per second (MIPS), or 20 million floating-point operations per second (MFLOPS). The system's standard version includes 12 extension slots and can also be connected to Ethernet and Fiber Distributed Data Interchange (FDDI) networks. For hooking up peripheral equipment such as CD-ROM, tapestreamers, and external disk drives, the Small Computer Systems Interface (SCSI) standard is used. The display has a resolution of 1536 x 1280 pixels.

The second workstation is called SPIRIT-I. This system is comparable to SPIRIT-0 but uses more (up to 32) and more powerful (50 MHz) 68040 processors. Its performances are accordingly higher: between 100 and 300 MIPS or 20 and 50 MFLOPS. These systems are expected to become available during the third quarter of 1993.

Finally, the SPIRIT-II workstation—which is due early 1994—will integrate as many as 32 of Motorola's 68050 processors, which are still being developed. This configuration will boost performances to a very high level: between 300 and 1000 MIPS or 50 and 200 MFLOPS. The system will also feature RISC [Reduced Instruction Set Computer] processors, probably chips based on Sun Microsystems' Sparc architecture.

The SPIRIT workstation is the result of international cooperation. The system components are therefore supplied by companies from several countries: The UNIX multiprocessor implementation, for instance, is supplied by Associated Computer Experts from Amsterdam; the mother board comes from the German company Kontron Elektronik; British Aerospace is developing the artificial intelligence used in the workstation; and the French company Caption will supply the graphics subsystem.

Several universities are also participating in the project: The Eberhard Karls university is developing the software for the 3D image processing; the Queen Mary and Westfield College is designing the graphics interface and object-oriented programming environment; and the School of Engineering is developing the architecture which supports the simulation and graphics options.

### **Belgian IMEC Develops Optical Circuit**

*91AN0315 Amsterdam COMPUTABLE  
in Dutch 15 Feb 91 p 13*

[Article by Eric Dauchy: "Belgians Announce Optical Computer Success; IMEC Develops Circuit Matrix"]

[Excerpts] Leuven—The research teams of professors G. Borghs and R. Vounckx of the Belgian Interuniversity Microelectronics Center (IMEC) claim to have succeeded in developing the first operational "PNPN optical circuit matrix." These circuits are essential components in optical computers. [passage omitted]

In a joint project, researchers of IMEC and the Dutch-language Free University of Brussels have now succeeded in developing such a component. This was achieved in the IMEC laboratory by making a sandwich structure consisting of very thin films of gallium arsenide and aluminum gallium arsenide. The films are only a few atoms thick because they are deposited, atom by atom as it were, using the molecular beam epitaxy technology. The optical and electrical properties of both elements [GaAs and AlGaAs] are such that in this structure, they acquire the exact properties so much searched for by optical computer designers.

Dr. G. Borghs admits that the new optical circuits will not yet leave the laboratory stage. The optical computer will not be around for some time. "However, science must be pushed by long-term perspective. Technological developments do not appear out of the blue but are the result of long and intensive research efforts."

### **Belgian Research Center Contribution To Industry Analyzed**

*91WS0217B Paris INDUSTRIES ET TECHNIQUES  
in French 22 Feb 91 pp 38-40*

[Article by Ridha Loukil: "When Research Creates Industry"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] No local industry? No problem! To exploit its research, Imec, a Belgian applied research laboratory for microelectronics will create industry itself. Now, people come from throughout the world to benefit from expertise in lithography, CAD....

Imec's success is founded in paradox. It was the research potential of the University of Louvain, estimated at 150 individuals in electronics, and not regional industry, nonexistent in this field at the time, which, in 1984, prompted the Belgian government to create this inter-university microelectronics center. Its mission: To exploit the basic research carried out at the university and, through technology transfers, to stimulate development of a true microelectronics industry in Belgium. It has proved to be worthy of the challenge. Imec has pulled it off with panache, by generating the industry which it desperately needs to exploit its research findings.

Although it did not actually go into operation until 1988, the center has already triggered the creation of four companies, which have become its technological windows into fields as crucial as lithography, electronic CAD, and solar cells.

The company Cobrain is a result of research into deep-UV lithography. Imec has the only photorepeater of this type in Europe, purchased from ASM Lithography. This ultra-sophisticated equipment uses an excimer laser (wavelength: 248 nm) from Lambda Physics as the light source to expose silicon wafers. This work led to development of the Desire process, a dry etching process which permits etching of 0.25-micron patterns on integrated circuits. Five years ago, it was still believed that optical lithography was limited to the micron. Cobrain is spreading this technology by marketing, along with the American company Matrix, etching equipment using the Desire process. Several machines have already been sold.

The company Soltech had a similar beginning—to exploit Imec's research on single-crystal silicon solar cells. EDC (European Development Center) went a different route. Founded by the American Silicon Compiler Systems, the company really took off thanks to the purchase of a version of the Cathedral software package—a silicon compiler developed by Imec—in exchange for the center's participation in its capital. This software is opening the way for the designing of signal processors in a few days, compared to a few months with conventional CAD systems. Another software package of this type is in the process of being transferred to EDC.

UBC [sic] Electronics likewise owes its existence to the Belgian research institute. A new subsidiary of UCB (Belgian Chemical Union), which participated in the development of the Desire process, it is permitting this company to diversify into dry developing resins. Interest in the process attracted the Japanese firm JSR, which contributed 50 percent of the capital of UCB Electronics.

The history of Mietec, which, along with UCB Electronics, is the pride of Belgian microelectronics, is similar. Mietec's creation by Bell Telephone coincided with Imec's birth.

With the center's support, this company rose quickly to become a leader in hybrid analog-digital ASIC's (application specific integrated circuits). This success resulted in its purchase by Alcatel and its assuming the role of a strategic subsidiary of the French group in the field of telecommunication ASIC's.

The productive collaboration between Mietec and the laboratory is continuing in the area of submicron processes. A 0.7-micron CMOS technique, ready for transfer to Mietec, has been perfected in Imec's prototype workshop. Roger Van Overstraeten, Imec president, feels that this result puts Imec at the forefront for such processes. Research is continuing with the objective of reducing the critical geometry to 0.5 microns toward the end of 1991. The Louvain laboratory uses Mietec's foundry at Oude-naarde to study certain problems linked to industrial scale production.

Imec does not confine itself to Belgium. Its partners include large European companies such as Philips, Siemens, SGS-Thomson, STC Semiconductors, and Matra MHS. "To be present in the field of semiconductor

production equipment, an area where Europe lags behind the United States and Japan, we must operate on the world level," admits Louis Hermans, the center's liaison with industry. Imec is thus managing 120 industrial contracts which will bring it, this year, between 550 and 600 million Belgian francs (1 French franc = 5 BF). This compares with the initial subsidy of 800 million BF allocated by the Belgian government. "Through these relationships, some companies simply want access to the equipment, CAD tools, or advanced software that we have; others go farther, participating in research carried out at Imec," Louis Hermans explains. As a result, the center's staff increases regularly in conjunction with the increase in industrial contracts. It now stands at 420, 70 percent of them researchers.

In the fields considered strategic, Imec is inaugurating a new form of collaboration with industry based on generic themes each of which interests several partners. Louis Hermans acknowledges the difficulty of bringing companies which are sometimes competitors together within a project. But the experiment seems to have gotten off to a good start with a research project concerning the cleaning of wafers between the various steps in the fabrication of chips. The problem of conflict of interest between the participants was resolved by opening this project up to companies working in complementary areas such as silicon wafers, ultra pure gases, chemistry, and chips. Some ten manufacturers, including some big Japanese names, are candidates for this program. Their participation will involve sending researchers to Imec, financing a part of the research, or even supporting a doctoral thesis. A similar program is being planned concerning rapid annealing processes used primarily to produce thin oxide films on silicon wafers. It involves companies working in furnaces, epitaxy techniques, nitrides, oxides, and chips.

Another form of collaboration involves resident manufacturers who come to Imec to apply the technologies developed there to their own needs. For example, about 10 Philips engineers are using the Cathedral software in the development of signal processors for the group's consumer electronics products. The Netherlands company OCE is evaluating the same software with a view to using it in the design of processors for image processing for its photocopiers. For its part, UCB has three engineers in the Imec clean room. The company is using the deep-UV photolithography line to develop new photosensitive resins. The company Olin Hunt is working in the same area, with two engineers assigned to Louvain.

In all, about 20 manufacturers are preparing in this way for the technological future of their companies without heavy investments in development or extremely costly equipment. According to Louis Hermans, this novel form of collaboration makes it possible to validate Imec's results, to find out what directions to take in development, and to discover new research topics.

Imec is becoming a hub around which an entire industry is emerging. "The number of resident manufacturers is

tending to increase. There are even companies setting up near us. This is the case with Philips, which is in the process of creating an 80-person design center at Louvain. Under the interested eyes of the Americans and Japanese," notes Roger Van Overstraeten. These are prospects which Imec's president finds more stimulating than ever.

### Use of Silicon, Gallium Arsenide Evaluated

91WS0217A Paris INDUSTRIES ET TECHNIQUES  
in French 22 Feb 91 p 34

[Article by Ridha Loukil: "Silicon Versus Gallium Arsenide"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] The opening of the general consumer market to hyperfrequencies is bringing with it a battle between the two semiconductor—cost versus performance, observed at the Hyper trade show (Paris).

Which semiconductor will be used for future hyperfrequency components? Silicon, an inexpensive material which has been mastered, or gallium arsenide (GaAs), an emerging technology with unbeatable frequency performance? The battle is being engaged in the area of new hyperfrequency applications. What was just yesterday an ultra cutting edge area reserved for the military is on its way to becoming an immense consumer market. Cellular telephones, tracking of mobile units, satellite television reception, navigation assistance, smart cards for identification, control, and remote payment...so many high volume applications which require consideration of the cost factor, whereas the traditional market, sensitive first and foremost to performance, generally opts for GaAs. The Hyper trade show, from 22 to 24 January, signaled the arrival of the first components for these new markets.

Cellular phones constitute the major market with several hundreds of thousands of vehicles to be equipped each year. The GSM European cellular telephone project plans initially to operate at 900-960 MHz.

In this frequency band, silicon is adequate for the most part. Whereas manufacturers like Motorola, NEC, Philips, or SGS Thomson remain loyal to silicon, others like Fujitsu or Mitsubishi seem to be casting their lot with GaAs. This is perhaps a way of anticipating the movement in the next stage to the 1.5-1.8-GHz band where GaAs will begin to be competitive with silicon. This competition already exists in the field of tracking of mobile units. The Locstar company, prime contractor in Europe for this project, has ordered 15,000 terminals for 1992. These terminals will equip mobile units (cars, trucks, trains, ships...) for real-time satellite tracking at a frequency of 1.65 GHz. Based on cost considerations, most manufacturers prefer silicon.

The choice has not yet been made for satellite television reception where the operating frequency of 12 GHz necessitates use of GaAs. Professional telecommunications (signal sensors, repeaters, and amplifiers for fiber

optics) will provide the transition between the military and this general consumer market—a market which, according to Thomson, should explode to reach 3 million units per year in Europe. Thomson-CSF is actively preparing for this. Its new GaAs plant, at Saint-Egreve near Grenoble, will implement two cutting edge technologies acquired from the American companies Anadigics and Vitesse Semiconductor—one for manufacture of analog circuits, the other for digital circuits—because all the applications require not only modules for signal transmission, reception, and amplification but also integrated circuits fast enough to control and process hyperfrequencies. Philips is counting on this development to realize a profit with its internal foundry at Limeil-Brevannes, already open to the outside for the design of GaAs ASIC's. The advent of a high-volume market is playing a key role in the development of these integrated circuits. Their attraction is all the greater because they are in the process of gaining a new application: data processing in large computers. Thus, for their latest supercomputers, Convex, Alliant, and Fujitsu have abandoned ECL technology, the fastest in silicon, in favor of GaAs. This movement underscores the interest in GaAs by contributing to a reduction in its cost.

However, silicon, with a current limit between 3 and 5 GHz, is not completely out of the picture. The Japanese, with a view to large volumes, hope to raise its performance to 40 GHz at a cost three to four times lower than GaAs. NEC is already producing circuits up to 22 GHz.

### Thomson's Color Liquid Crystal Displays Described

91WS0219C Paris L'USINE NOUVELLE/  
TECHNOLOGIES in French 14 Feb 91 p 13

[Article by Thierry Lucas: "Flat Color Screens Manufactured; first paragraph is L'USINE NOUVELLE/ TECHNOLOGIES introduction]

[Text] Thomson has begun production of its "active matrix" flat color screens for their first customers: military aircraft.

Just a year after construction began on the Moirans factory, the first series of 22 cm diagonal flat color screens (6.25 x 6.25 inches) is in production. Thomson-LCD, a subsidiary of Sextant Avionique and Thomson Consumer Electronics (TCE), has delivered real performance, considering that the products in question are made of matrices containing over 1 million pixels, each consisting of a tiny control transistor connected to a liquid crystal microcomponent. Manufacturing these high-end screens—currently being produced for aeronautical and military applications—requires 1,800 m<sup>2</sup> of clean rooms, of which over half are class 10 and class 100.

Based on General Electric technology, the Thomson-LCD flat color screens are "active matrix" displays. An "active matrix" is obtained by successively depositing thin layers of a semiconductor (amorphous silicon) and

insulation on a glass substrate and then photoetching them. Things get even more complicated with color displays. These screens call for a second glass sheet, on which red, green, and blue filters are placed. The filters are actually three layers of dye, which are photoetched in turn to produce a mosaic of the three primary colors. The final step is to put the two sheets together, maintaining a constant gap of a few microns. To do so, Thomson has developed an original technique of placing calibrated spacers on the transistors themselves (thereby simultaneously protecting them from ambient light). Partial vacuum is used to draw the liquid crystal between the sheets—a critical step during which the correct molecular orientation is obtained. In addition to the 6.25 x 6.25 screens inaugurating the line, other Thomson-LCD products are nearing release. A 5 x 5 prototype will be delivered to Dassault for the Rafale. Four 6 x 6 displays are scheduled for Aerospatiale's Tigre helicopter. Lastly, 6 x 8 screens have been designed for military transport aircraft with conventional instrumentation.

This is one way of "getting in practice" for predicting the great screens of the HDTV [high-definition television] future.

#### **Philips Upgrades CCD Sensors**

91AN0311 Paris *ELECTRONIQUE INTERNATIONALE* HEBDO in French 28 Feb 91 p 21

[Text] A scientist at the Philips research laboratory in Eindhoven has succeeded in improving the sensitivity of CCD (Charge Coupled Device) sensors by coating their electrodes with a tin-indium (SnInO) layer, a material which is both transparent and conducting. This operation generally produces crystalline defects in the silicon oxide. The scientist's work thus consisted in minimizing these defects and in studying the possible scaleup of this development to mass production, which requires a process that is stable as well as compatible with CCD sensor manufacturing technologies.

The SnInO layer is deposited in several stages. The tin and indium atoms are first extracted from a tin-indium cathode by magnetron sputtering and low-pressure ion bombardment in a plasma of argon and oxygen. They then combine with the oxygen to form tin indium oxide, which is deposited on an oxidized silicon wafer. As in other chip manufacturing processes, the SnInO layer is then etched locally by exposure through masks. The scientist succeeded in obtaining linewidths of 2 microns with 2-micron interspaces.

Furthermore, in order to obtain good contacts at the electrodes, a double layer of aluminum on tungsten titanium has been developed. The contact resistance obtained in this way is 40 times lower than before. By combining a heat treatment at 950 °C for about 30 seconds with another treatment at lower temperature in hydrogen, the crystalline defects were reduced substantially.

This laboratory work, which was carried out in the framework of the European Strategic Program for Research and Development in Information Technologies (ESPRIT), is, however, still at the research stage at this time.

#### **Italy: Status of SGS-Thomson's Projects Presented**

##### **Integrated Circuits**

91MI0277A Rome *FINMECCANICA NOTIZIE* in Italian 28 Feb 91 pp 9-10

[Text] The EEC Commission has authorized the Italian government's 87.3 billion lire support plan for SGS-Thomson to promote the research program on "highly complex personalized and programmable integrated circuits." The financial intervention falls within the framework of the fund for applied research and will consist of interest credits and capital at venture.

The overall total investment necessary for the development of the project is 283.1 billion lire, of which the government's participation will cover 50 percent of the basic research and 25 percent of the applied research.

The Brussels executive committee decided to give the go-ahead to the plan since government aid "supports technical progress without altering the conditions of trade between the member States to a degree that is contrary to mutual interests."

##### **EEPROM Devices**

91MI0277B Rome *FINMECCANICA NOTIZIE* in Italian 28 Feb 91 pp 11-12

[Text] SGS-Thomson Microelectronics, one of the world leaders in the area of nonvolatile memories, has added three new devices to its EEPROM [electrically-erasable programmable read-only memory] line. These devices combine an extremely high data retention capacity with a serial bus that reflects industrial standards and are presented as the ideal solution for a wide range of applications requiring the timely and nonvolatile storage of data.

The possible sectors of application for these products include: television (memorizing tuning, volume, brightness, and color data); telephone equipment, cordless telephones, computer peripherals to memorize configuration parameters, and industrial tooling, where they represent the ideal solution for memorizing reference curves, calibration data, and minimum and maximum values.

The Finmeccanica company has also introduced an integrated interface device on the market that simplifies the development of printed circuit cards and permits terminals to be designed with modular architecture. The new component integrates a four wire interface (two for transmission and two for reception), through which the device can be interconnected to other components on the

printed circuit card, by using the GCI (General Circuit Interface) multiplex bus. This enables the physical layout of a printed circuit card to be simplified, and permits many metallic tracks to be eliminated.

#### **UK: Inmos Presents T9000 Transputer**

91AN0400 Chichester INTERNATIONAL  
TELECOMMUNICATIONS INTELLIGENCE  
in English 15 Apr 91 pp 7-8

[Text] Telecommunications switching systems, intelligent networks, broadband fast-packet data transmission equipment, fibre-optic terminals and colour facsimile terminals are among the prime target markets for a new British-designed "super" microcomputer chip, full technical details of which were made public for the first time today, April 15th.

The T-9000 transputer was developed at the Bristol, UK, design centre of Inmos Ltd, a subsidiary of French-Italian group SGS Thomson Microelectronics. Product Marketing Manager, Matthew Hatch, told ITI that the chip will be capable of a computing performance of more than 250 million instructions per second (MIPS) and be able to perform more than 25 million floating point operations per second (MFLOPS). By comparison, the recently-announced upgraded version of Motorola 88000 reduced instruction set computer chip, chosen by a number of digital switch makers as the basis for their processors, is rated by its manufacturer at 100 MIPS.

But for telecommunications equipment builders, its more significant features are four built-in physical communications links, each of which is able to transfer data at a sustained rate of 100 Mbit/s. Hatch says that the four physical links can be multiplexed to give a combined bi-directional bandwidth equivalent to 80 Mbytes/s. In addition, using a cell-based multiplexing protocol, each physical link can be programmed to provide up to 64,000 virtual channels of communication.

Primarily the links are intended to provide intercommunication between different software processors running on different transputer chips, interconnected in a parallel processing network. "The architecture is designed to be full scalable," Hatch told ITI, "so that processing power can be increased linearly by simply adding more transputers to a network".

Design team leader, Clive Dyson, points out that the link protocol is based on a cell structure not unlike that used for high-speed asynchronous mode transfer switches now being developed in telecommunications laboratories around the world. "Messages are split into a sequence of packets, each comprising 32 bytes of data," he explains. "Each virtual link has an associated control block which contains a header which is appended to all packets sent down the physical link". This header defines the destination of a packet within a network of transputers. On arrival, the receiving process, or software task, returns an acknowledgement before the next packet is transmitted to it. "The whole process is so fast, that continuous

transmission at maximum rates can be achieved under most circumstances," Dyson says. To ensure correct functioning, the communications process is supervised by built-in monitoring circuits, which use two additional, dedicated, control links per chip.

Dyson says that depending on the topology chosen for a computing network, the T-9000 chip has the ability to act as a message router, passing messages on to other chips in the network if necessary. However, for very large networks, Inmos has designed another device, the C-104, which it designates a Packet Routing Switch. This uses a technique that Inmos has named "Wormhole Routing," to ensure that messages are passed through the network with negligible delay.

When the C-104 receives a packet, it reads the header and immediately creates a temporary circuit through its 32 by 32 crosspoint routing matrix to the destination device—a "wormhole" through which the data flows. As soon as it detects the tail of the packet, the circuit is closed and the switch matrix becomes available for routing the next packet—or as Dyson graphically describes the process "as the tail of the data packet is pulled through, the circuit vanishes behind it." This process is achieved with a latency of less than one microsecond, he says.

The concept is taken further, when a route through a network may require a data stream to pass through several C-104 chips. Dyson says, "A packet can be passed through several nodes at the same time, since the header of a packet can be received by a switching node before the whole of the packet has been transmitted". Further flexibility can be ensured in networks with complex topologies by concatenating headers. In these circumstances, a T-9000 chip may be programmed to manage a network, and have a series of destination headers added to each data packet to define its route through the network to its desired destination. As the packet passes through a series of addressed switch nodes, each strips its own address header from the packet, until only the address of the destination processor is reached.

Dyson claims that using the "wormhole routing" technique, large arrays of C-104s and transputers can be used to build very large communications networks "by combining smaller subnetworks."

Raw processing power though is not all that the T-9000 has to offer. Hatch claims that earlier transputer chips—the first was launched in 1985—have found wide applications in telecommunications equipment around the world. And Inmos has taken great care to ensure that the development effort spent in designing software and hardware systems around the earlier chips will not be wasted. "Although it is a totally new design," he says, "we have taken great care to ensure that existing transputer programmes will run on the new processor." In fact, he claims that the only difference the user will notice if he replaces an existing T-800 transputer with a T-9000, is a 10 times increase in processor speed.

Indeed, with over 1,000 projects around the world based on the earlier devices, Immos has taken great care to include them in the development process. Hatch says that there is a Transputer Developers Club with over 60 members in Europe, the U.S. and Japan. As a result, the T-9000 is actually "evolving into the marketplace," as Hatch puts it, rather than being launched with a big bang. Already, he claims the T-9000 is being designed into a number of products.

Commercial security dictates that most of these have to remain top secret, however. Hatch told ITI: "One Japanese manufacturer plans to use a network of six T-9000 chips in a colour photocopier, a U.S. company is making a graphics workstation with the chip, in the UK it is being designed into a military radar system, and in the UK, Germany and France, four companies—Meiko Ltd, Parsys Ltd, Telmat SA and Parsytech GmbH—are building T-9000 supercomputers." He says too that the design team is working closely with most of the world's leading telecommunications switch makers.

Hatch also indicates that Immos itself is working on the development of a low-cost FDDI (fiber distributed data interface) terminal interface based on the T-9000. "The semiconductor process we are using for its manufacture will allow the chip to run even faster than the 50 MHz clock speed we use at present," he says. So hitting the 100 Mbytes/s plus data rate required for FDDI is unlikely to be arduous.

Low cost is assured, too. Although prices will not be finalised until the T-9000 becomes commercially available early in 1992, Hatch says that in order to make its way in its chosen market as an embedded 32-bit processor, "it will be priced, initially, at less than \$500."

He refuses to be committed to a more accurate price, but does not disagree with London-based Dataquest analyst, Mike Glennon, who says that the target price for such a processor, "regardless of its performance capabilities" must fall in the range of \$200 to \$400.

"And, within two to three years, that price will have to have fallen to nearer \$100," Glennon adds.

#### **Advanced Swiss Amorphous Silicon Deposition Process Described**

*91WS0200B Paris INDUSTRIES ET TECHNIQUES in French 8 Feb 91 p 107*

[Article by Ridha Loukil: "Amorphous Silicon Deposited Five Times Faster"; first paragraph is INDUSTRIES ET TECHNIQUES introduction]

[Text] Quality and speed go hand in hand with this process, which can be applied in particular to photovoltaics.

There is no longer any need to choose between speed in amorphous silicon deposition and the quality of the

material deposited. The Neuchatel Microtechnical Institute has created a technique for making thin films that combines the two advantages. The technique, which is derived from the process of chemical vapor deposition, offers production rates five times higher. A photovoltaic cell can be made in 10 minutes, instead of the 60 minutes required before.

This performance is the result of a research project funded by the Federal Office of Energy, in Switzerland. Its objective was to make solar energy more attractive by reducing the production costs of photovoltaic cells. Other applications such as flat screens, liquid-crystal display, and X-ray detection and analysis were also targeted by the researchers. Amorphous silicon is a key material in the development of those applications. It is a thin film of this semiconducting material that is used, in photovoltaic modules, to convert solar energy into electricity. With silicon atoms "arrayed" in a disordered fashion, it is easier to obtain than a layer of crystalline material.

#### **Better Physical and Electro-Optical Characteristics**

Naturally, for quality reasons, the Neuchatel Microtechnical Institute gave preference to plasma-enhanced chemical vapor deposition (or PE-CVD). A gas containing atoms of silicon, in this case hydrosilicon, is introduced into a vacuum chamber. It is ionized using a high-frequency system, and forms a plasma between the system's two electrodes. The silicon molecules, separated by the plasma, are deposited on a glass substrate.

Compared to the nonplasma CVD method, the process has the advantage of lowering reaction temperature, which enhances the physical and electro-optical characteristics of the material deposited. Its low deposition rate is a serious handicap. With a deposition speed of one micron an hour, large-scale production of films larger than 0.5 micron seems difficult to imagine. To increase the deposition rate, researchers studied the influence of reaction parameters on deposition speed and on the quality of the material deposited. An extensive investigation of pressure in the chamber, reaction temperature, plasma density, excitation frequency, and the shape of the reactor was carried out. Only the excitation frequency proved of interest in reconciling the goals of increasing the deposition rate while maintaining quality.

The industrial frequency used on these systems is 13.56 MHz. However, experiments at Neuchatel show that the optimum frequency is 70 MHz. The deposition rate increases with frequency, reaching a speed of 20 to 30 microns an hour, but begins to decline starting at 70 MHz. Four systems were built for the laboratory. The researchers' work shows that at 70 MHz, the process is suitable for thick film applications requiring some 10 microns of amorphous silicon. That is what is required for opto-electronic detectors, photosensitive layers in photocopiers, and particle detectors. The institute was able to make a 100-micron layer in this way without too

much trouble: a job that would have taken several days with the old 13.56 MHz system.

## NUCLEAR FUSION

### France: Thomson Establishes HDTV Subsidiary

91AN0375 Newbury FRANCE ALERT in English  
3 Apr 91 p 20

[Abstract of an article published in Paris LES ECHOS 21 Mar 91 p 8]

[Text] TCE (France), consumer electronics subsidiary of Thomson (France), has established Ex Camera under which all its HDTV production operation will be grouped. The company will lend its facilities, at present two units but about ten at the time of the Albertville Olympics, to the Vision 1250 consortium, the European body charged with promoting the HDMAC format.

### French Firm Develops High-Capacity Optical Disk

91AN0376 Newbury FRANCE ALERT in English  
3 Apr 91 p 44

[Abstract of an article published in Paris LE MONDE INFORMATIQUE 25 Mar 91 p 15]

[Text] ATG Gigadisc (France) has developed a 12-inch WORM (Write Once Read Many) non-rewritable optical disk with the highest storage capacity yet to be achieved (9 Gbytes). Costing 7,448 French francs [Fr], the new disk runs on a new, Fr216,000 drive, the Gigadisc 9001. The new drive will also be able to read ATG Gigadisc's previous WORM disks. The 19-inch rack-mounted Gigadisc 9001, offers a 1 Mbyte/s transfer rate, sector access time of 33 millisecs, a 30 k hour MTBF and an SCSI I or II interface. ATG Gigadisc should begin mass production at the end of the current half-year, and is shortly due to produce a 5-disk automatic loader. The development of the 9 Gbyte, MCAV mode, WORM disk will increase the capacity of the largest Cygnet juke-box configuration sold by ATG Gigadisc to 1,269 Gbytes. Meanwhile, Dorotech, an integrator of optical disks under Unix, has acquired a majority interest in ATG Gigadisc.

### Italy: Nuclear Reactor Consortium's Activities Presented

91MI0275 Rome FINMECCANICA NOTIZIE  
in Italian 28 Feb 91 p 2

[Text] The Genesi (High Intrinsic Safety Electronuclear Generators) consortium established by Ansaldo and Fiat Ciei in May 1990 to promote, study, develop, and design nuclear reactors with greater intrinsic and passive safety has signed an initial design and study contract valued at 15.5 billion lire with ENEA [Italian Committee for R&D of Nuclear and Alternative Energies].

Ansaldo's division and Fiat Ciei will work on this contract during 1991 and activities will cover the following major areas of critical importance for the next generation of nuclear reactors:

- Subsystems and components with a high intrinsic and passive safety level; including the development of innovative valves as well as passive actuation and shutdown systems;
- advanced containment systems to ensure that even following serious accidents the evacuation of the population around the plant will not be necessary;
- core and fuel: studies will concentrate on intrinsic and passive systems designed to shut down the core;
- man-machine interface, focusing on accident diagnostics and reducing the risk of operator error.

The contract covers the first part of a three-year program of activity already agreed upon by ENEA and Genesi. The program falls within the broader context of activities by ENEA, ENEL [National Electric Power Company], and private industries to develop an innovative nuclear system as indicated in the National Energy Plan within this time frame.

## SUPERCONDUCTIVITY

### France: High-Temperature Superconductor Developed

91AN0321 Paris SCIENCES & AVENIR in French  
Mar 91 p 14

[Text] French researchers have broken all records in the area of high-temperature superconductors. The Alcatel Alsthom Recherche (AAR) company has developed a 9-mm<sup>2</sup> sample that can conduct an electrical current of up to 1,000 amperes at a temperature of -196 °C. This is the highest intensity reached thus far. The sample in question is a bulk conductor that loses virtually all resistivity when immersed in liquid nitrogen. This is not the first success achieved by AAR engineers; they had already broken the current density record in the area of superconducting ceramics.

### Germany Develops High-Temperature Superconductor Applications

91MI0269 Bonn WISSENSCHAFT WIRTSCHAFT POLITIK in German 20 Mar 91 pp 4-5

[Text] The BMFT [Federal Ministry of Research and Technology] has budgeted 390 million German marks [DM] for joint projects under the overall funding program on superconductivity (both liquid helium- and nitrogen-cooled) scheduled for continuation until 1995. This statement was made by Federal Research Minister Dr. Heinz Riesenhuber at the presentation of an "interim report" on high-temperature superconductivity (HTSC) in Bonn, which he combined with an illustration of two fields of application. By the end of 1994, DM50 million will have been spent on "Initial HTSC Applications in microelectronics/cryoelectronics

(=low-temperature electronics). "SQUID's" (superconducting quantum interferometer devices) are playing an increasingly important role in medical diagnostics, for instance, to "record" brain currents.

At present, SQUID's are the most sensitive detectors of magnetic fields. They consist of a superconducting ring incorporating at least one weak point (consisting of a Josephson contact). This weak point limits the supercurrent in the ring, the maximum value of which gives the measure of the magnetic flow through the ring.

To date, SQUID's have been made of conventional superconductors, such as niobium, that had to be cooled with liquid helium. The development of SQUID's using high-temperature conductors has led to a drastic reduction in the cooling requirements for these sensors because they work at temperatures nearly twenty times higher. In Bonn, Research Minister Riesenhuber presented a SQUID made with the superconductor  $\text{YBa}_2\text{Cu}_3\text{O}_7$  and produced at the Juelich Research Center's Institute of Coating and Ion Technology. It is cooled with liquid nitrogen, which is much cheaper, and at signal frequencies above 200 Hz still achieves a sensitivity approaching that of commercial niobium SQUID's of similar design. This sensor can already be used in a series of applications previously exclusive to helium-cooled SQUID's.

Apart from "decoding" brain signals, other biomagnetic signals, for example, from the heart, can also be interpreted, and damage can thus be precisely located.

The very weak magnetic fields to be registered require effective suppression of interfering extraneous fields. Interference fields emanate from many sources, such as passing motor vehicles, elevators, electrical appliances, etc. The effect of interference fields can be greatly reduced in special protective chambers.

As well as establishing itself as a sensor for biomagnetic signals, the SQUID has already proved an indispensable aid in a wide range of natural science research tests. According to Prof. Christoph Heiden of the Juelich Research Center, the SQUID's noise level still requires technical improvements: Better alloys will be used to eliminate its low-frequency inherent noise.

## TELECOMMUNICATIONS R&D

### Europe's First Public MAN Inaugurated

91AN0350 Chichester *INTERNATIONAL TELECOMMUNICATIONS INTELLIGENCE* in English 25 Mar 91 p 1

[Text] Denmark has become the first European country to have a high-speed (34 Mbit/s) public data network built around Metropolitan Area Network (MAN) technology.

In Copenhagen, the local area networks of a "large pharmaceutical company" are interconnected across the

public MAN operated by Copenhagen Telephone Company, KTAS. The network operates at 34 Mbit/s and is in line with the Distributed Queue Dual Bus principle which forms the basis of IEEE's 802.6 standard.

Siemens has provided the equipment for the network infrastructure, manufacturing the necessary elements in Bruchsal under the terms of its licensing agreement with QPSX Communications, the Telecom Australia subsidiary, which developed MAN technology.

A Siemens spokesman told ITI that it was building similar networks for PTOs (Post and Telecommunications Offices) in Italy (SIP), Germany (DBT) and the U.S. (Bell Atlantic). Public operation of the Italian MAN is expected this week, while negotiations with U.S. West in the United States have recently been initiated, the spokesman said. The DBT's MAN in Munich will be operational in mid-1991.

### Italy: Satellite Telecommunications Conference Summarized

91MI0245 Rome *SPAZIO INFORMAZIONI* in Italian 6 Mar 91 pp 2-4

[Text] The availability of diversified telecommunications services via satellite—primarily to meet the specific requirements of business operators—is arousing considerable interest in our country. This point was confirmed by the Minister of Postal and Telecommunications Services, the Honorable Oscar Mammi, at a recent European symposium on Telecommunication Services via Satellite, held in Rome by SIP [Italian State-Owned Telephone Company] and Telespazio. In his speech, Minister Mammi pointed out that while these services have been operating for quite some time, "there is a need for a large-scale increase in their direct supply to customers. The reliability of satellite networks is such that they are particularly suited for top-quality services to the business sector for which speed in connections, safety, and confidentiality are fundamental. All this," he added, "is obliging telecommunications management companies to adapt themselves to 'standards' that are undoubtedly higher than those currently offered by the basic network, by developing an intelligent capillary structure and through the timely repair of any breakdowns that inevitably arise".

"The Italian telecommunications industry," the minister added, "both in terms of its institutional and pricing structures, has evolved by paying little attention to the market and the requirements of economic operators, by favoring 'the interests of society' which is often an alibi for very low quality standards. The initiative that SIP and Telespazio are currently undertaking should be well received since it fits into a different plan and is more consistent with the need to face competition in a more open market. Without a doubt," he concluded, "everyone is aware of the fact that the lawmakers, who have been spending too much time reviewing the reorganization plan proposed by the government in April 1989, are also responsible for this worrisome delay."

### Statements by SIP and Telespazio

"Satellite technology," noted Dr. Raffaele Menicucci, managing director of Telespazio, "has already been successfully adopted by several countries, since it provides a cost-effective, flexible solution to the communications requirements of the business world. Telespazio was able to study these solutions carefully by operating in an international context, and introduced VSAT (Very Small Aperture Terminal) technology and business television applications, both of which are already well-established in the United States, to Italy and Europe. In this way it anticipated innovative solutions and answers to the new and growing communication needs of the market. The major, tangible advantages of the specific features of satellite systems and VSAT technologies include: 1) good connections which are an essential element in increasingly complex communications activities; 2) excellent link-up accessibility, in excess of 99 percent of transmission time, due to the very low risk of breakdowns in service; 3) speed and flexibility in the installation and reconfiguration of satellite networks, thanks to the small size of the VSAT antennas; 4) a wide range of transmission speeds. I would also like to emphasize." Dr. Menicucci concluded, "that Telespazio has already installed 400 VSAT's throughout the country and, once again ahead of other European operators, has already made a bid for international link-ups (the Rome-Brussels link for the Ministry of Foreign Affairs is an example) in a 'one-stop-shopping' context, i.e., a one-way channel to the user."

"I am pleased to have the opportunity to emphasize the importance of satellite telecommunications for SIP today," Dr. Francesco Silvano, managing director of SIP, noted, "and to confirm our commitment and willingness to cooperate in any initiatives and projects which, through the adoption of satellite technology both nationwide and worldwide, deal with the new communication needs of users. Today, satellites are generally used in two major fields of application: 1) telecommunications network-oriented applications; 2) user-oriented applications. In the former application, satellites are used to complement ground systems or as emergency systems. In both these cases they are used to increase the capability to reconfigure the transmission network of ground stations with the maximum degree of flexibility. A current example is represented by the Italsat system, which may become a new element in the national telecommunications network, the evolution of which will have to parallel the evolution of the most advanced ground networks (digital network, ISDN [integrated services digital network], intelligent network). As for user-oriented services, SIP began to rely on satellites in the late 1980's when EUTELSAT and INTELSAT, the space sector's managing consortia, provided dedicated transponders, SMS (Satellite Multiservice System), and IBS

(Intelsat Business Services) that were capable of offering digital connections to support a wide range of communication services, regardless of the nature of the information (voice, data, texts, and images)."

"Telespazio's participation in these consortia," Dr. Silvano emphasized, "coupled with SIP's keen perception of the possibility of using satellites to meet the new requirements of major users, permitted us to translate technological resources immediately into targeted equipment." He concluded by saying, "Today, Europe has the largest number of satellite systems for business purposes, and we believe that the experience and know-how we have acquired in the sector will make us competitive in the new single European market."

### The Situation in Italy

The status of the activities and programs of Italian government agencies involved in the telecommunications industry was presented at the Rome symposium by Eng. Francesco Rossi of SIP's general management board, who pointed out that these activities are directed toward both the use of open user networks and the supply of closed user networks. "Following an initial assessment of the number of potential users and their location in the country," said Rossi, referring to open user networks, "SIP has planned and developed five stations, located in the main metropolitan areas of the EEC with a high concentration of business users. The first two 'standard 1 Eutelsat', stations which have been operating in Rome and Milan since 1988, were supplemented with the Turin and Bologna EC stations in 1990, while a fifth station is currently being installed in Palermo. SIP, furthermore, has recently purchased the first two vehicle-mounted 'standard 3 Eutelsat' mobile stations for video conferences and data transmission. These are to be supplemented, by mid-1991, with two additional stations that will be used primarily in southern Italy. On the basis of a technical-economic analysis of the application," Eng. Rossi stated, referring to closed user networks, "SIP, in cooperation with Telespazio, has developed two Master stations, featuring the TDM/TDMA [time division multiplexing/time division multiple access] access mode to optimize the use of the space segment and the system's overall capability. User acquisition activities are currently under way for these two systems, which have been installed in Rome and Milan respectively. A third system, using the same technology, will enter into service by end of year in Bari, within the framework of the EC's STAR [Special Telecommunications Action for Regional Development] program, and is designed to expand telecommunications infrastructures in southern Italy. Finally, to meet more specific requirements in the area of data distribution, a unidirectional addressable VSAT system has been developed in cooperation with national industries. SIP has recently installed two Master stations of this system, referred to as Linksat-1, in Rome and Milan" he concluded.

## COMPUTERS

### Hungarian Firm To Become East European Supply Base

91WS0235A Budapest *COMPUTERWORLD*/  
SZAMITASTECHNIKA in Hungarian 20 Dec 90 p 7

[Article Z. M.: "Agreement in Tandon Case"]

[Text] In issue number 48, 1990, of our journal we promised to report on the outcome of the talks being conducted concerning domestic sale of Tandon products. Well, the participants—the Omikron Small Cooperative, as domestic distributor, and the Austrian commercial house Philimex and Tandon Europe, also involved—very quickly cleared up the disputed questions.

To turn immediately to the essence, according to the contract now signed the Hungarian representative of Philimex, Global Trade Limited, can work as the Omikron dealer. At the same time Philimex got the right from the European division of Tandon to sell the products of the firm directly in other countries of Eastern Europe, with the exception of Yugoslavia and Albania.

And what is the situation with the Alfa Fokusz firm which, as we wrote in the article cited, precipitated the dispute when it appeared with Tandon computers? In the name of Philimex Gottfried Hauptmann asked us especially to write that Alfa Fokusz and its marketing director, Zoltan Paulo, who made the statement at the Compfair, are not authorized to use the Philimex name or deal in Tandon products.

"We are happy that the problem was solved quickly," said Laszlo Furedi, president of Omikron. "The painful situation arose when real competitors to the Tandon machines appeared in Hungary, products of manufacturers emphasizing quality, Compaq for instance. Now we can face the competition united and strengthened. We can offer the entire product scale—we also got the first export permits for the 486 systems. We consider it important that there not be any areas in the country not covered. Our goal is to have the Tandon name mean a

uniform price everywhere, coupled with fast service. In this spirit, and taking care to prepare an expert staff, we have signed or are signing dealer or retailer contracts with a number of provincial firms."

"We think the same way," said Gottfried Hauptmann in turn. "It can be imagined that Global Trade will set up a shop network where one will be able to buy entertainment electronics in addition to computer technology. We now have a sales agreement with the Villvakisz Small Cooperative in Tatabanya, it has bridgeheads in Western Hungary. We will soon start a big joint Tandon advertising campaign—primarily in Transdanubia."

We learned from business director Gyula Toth that Villvakisz is a small cooperative with many interests, it has hardware and construction industry branches too, the computer division of which worked for several years as a subcontracting service organization for Muszertechnika [Instrument Technology]. Today, however, it is selling PC's itself as well. They have four show rooms or service offices in Transdanubia and now they are expanding their network in the direction of Budapest and the Alföld [Great Plain].

So now, after the Omikron-Philimex (Global Trade) agreement, how many places will there be Tandon sales and service in Hungary, in addition to the two firms mentioned? The Omikron partners are Erdoszov [Forest Cooperative] Computer Technology (Szolnok), Expertus Limited (Veszprem), Full Contact Limited (Debrecen), High Comp Limited (Kecskemet), Marker Limited (Budapest), the Ramorg Gmk [Economic Work Group] (Zalaegerszeg), Softinvest (Budapest), Trigon Hardver Limited (Budapest), VerComp Limited (Gyor) and the Villvakisz show rooms and service offices in Gyor, Kaposvar, Szombathely and Tatabanya.

Now that there are disputes about domestic sale of a number of famous Western products we consider exemplary the swift, cultured settlement of the Tandon case. A customer would be well advised to get his computer and his service near to where he lives, under uniform conditions which are absolutely legal throughout the country. And the entire Hungarian market would be well served as well, for the Western judgment of it will be damaged if the wrangling over rights is prolonged.

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